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The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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Foundry Costing

Elsewhere in this issue the question of foundry costing is again raised semi-officially by the publication of additional suggestions from the Costing Sub-Committee of the Institute of British Foundrymen. These notes will be presented during the spring to the various branches of the Institute for discussion, and opportunity will be afforded for criticism from a wide area. It seems desirable that as far as possible these contributions should represent not so much the personal view as those of the concerns they represent, as it quite often happens that the two are at variance, and as the ultimate object is the standardisation by the units of the industry, it is of paramount importance that the actual firms' reactions should be put forward. There are a number of employers' associations which employ auditors as their secretaries, and the opinions of these gentlemen would be extremely valuable, for there is no more potent remedy against price cutting than a proper appreciation of manufacturing costs. It will be noticed that in the tentative Report the word "home scrap" is used to designate this type of material, which has not been bought but has been returned from the foundry to the melting department in the form of runners and risers and the like. This word has been standardised by the appropriate committee of the Institute, but in spite of that we think the word "back" scrap is preferable, as it indicates the movement invariably to be associated with this type of scrap.

We are reasonably certain that the allocation of overhead costs on the basis of direct labour is certain to receive much criticism, as some think it overburdens the large jobbing section at the expense of the smaller castings made on the machines. It is, however, a better basis than materials, but it is possible that a factor built up of material (metal) and direct wages is a better mathematical approximation. We appreciate the argument that the source of information—direct wages—is always available and reliable, and this has much to commend it as a basis for the allocation of overheads. We wish to congratulate the sub-committee on the very good progress it is making, and reiterate that it is a real service to the foundry owners, to whom we suggest that they accord the Report their very serious attention so that later steps may be taken for national adoption after unification.

Miscellany

Our readers will in all probability not feel inclined for serious reading so soon after the Christmas festivities. Most of us will be fully entitled to the relaxation that the holiday provides. For if a period of depression has its anxieties, a period of expanding business makes a great call on our physical and mental powers. No less a person than the Chancellor of the Exchequer has expressed almost a measure of bewilderment that our prosperity should go on increasing. By all the signs he can normally use as an index, there is as yet no evidence of any halt. The official figures for exports continue to improve, and we foresee a happy New Year for all.

The weather just before Christmas reminds us again how much our great systems of transport and communications are at the mercy of frost and fog, in spite of all our scientific advances. Great satisfaction is expressed by drivers of the non-skid properties of cast-iron blocks, a quarter of a mile stretch of which has been laid in Islington, partly laid some three years ago and now extended. Taxi drivers say that if they get one wheel on the iron they are safe, the middle of the road having tram lines laid in treacherous granite setts.

We thought that a recent act of the Soviet Government threw a very creditable light on this country. In 1934 the Soviet Government refused permission for Prof. Kapitza to return to England on the ground that his services were required in Russia, where a special laboratory was being built and placed at his disposal. He is a Soviet citizen. The reputation he has made and which is responsible for this decision has been built up at Cambridge. Not only did he have facilities for working there, but the Royal Society in 1933 established the Mond Laboratory at Cambridge to allow Prof. Kapitza to continue to develop his work. The U.S.S.R. has offered to buy and the Cambridge authorities have agreed to send the special apparatus in this laboratory, which will be continued on rather different lines in future.

Those of us who have ever sat for examinations have chuckled at the discomfiture of examiners revealed in a recent report which examines the examiners and their methods. We hope to return to this later.

XUM

Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Labour Turnover

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—May I make a few observations on the review of this Society's recent booklet "Labour Turnover and How to Reduce It," which appeared in your issue of November 28?

After pointing out the advantages of labour turnover *per se*, your reviewer says that the "only useful part of this book is the disclosure of a common-sense method of computing and recording labour turnover." This is an obvious contradiction. If unrestricted labour turnover is advantageous, what purpose can be served by computing and recording it, except perhaps to increase it to the uttermost possible limit? Indeed, why not recommend a complete change of staff yearly as the ideal?

If your reviewer had read the first paragraph of the booklet carefully he would have appreciated the fact that it is not labour turnover as such which is pointed to as a fault of management, but excessive labour turnover. Thus the paragraph quotes with approval the opinion of the Balfour Committee on Industry and Trade that "mobility is the very breath of life of modern industry."

This Society, which is a body composed of about 1,000 firms, has had over 15 years' experience of the difficulties which many firms have met with in controlling their rate of labour turnover, and it has in the course of this work received countless requests from firms for information as to the proper method of computing labour turnover rate, as a step to overcoming this difficulty. It is to meet this continual demand from British industrial firms that the booklet has been prepared.—Yours, etc.,

ROBERT R. HYDE.

Industrial Welfare Society
(Incorporated),
14, Hobart Place,
Westminster, S.W.1.

December 16, 1935.

Catalogue Received

Iron Castings. We have seldom seen such an excellent collection of advertisements for castings as is contained in a new brochure issued by John Harper & Company, Limited, of Albion Works, Willenhall, but they do not blend into one harmonious whole. Other criticisms we have to make are that sepia should have been used and pale blue instead of deep orange would be preferable for the bulk of the matter. Yet we insist that each individual page is a splendid example of modern publicity. The first one entitled "Smoother than the Human Skin" and the last one are of outstanding quality, because of the moderation used in the colour, which, on account of its aggressiveness, has spoilt pages 2, 3, 4, 5 and 6. It is an extremely wise action to include two tear-off business reply cards, one for plain and the second for nickel cast iron. Castings lend themselves with difficulty to publicity, and this brochure is an excellent attempt but has, somehow, probably to choice of colour, just "missed the boat."

THE ANNUAL DINNER of the London Iron and Steel Exchange will be held at the Dorchester Hotel, Park Lane, W.1, on Tuesday, February 4. The Rt. Hon. Walter Runciman, M.P., President of the Board of Trade, will be the principal guest. Mr. C. Bruce Gardner, chairman of the Exchange, will preside.

District Presidents.—No. 5

SHEFFIELD BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN

Mr. Arthur Whiteley, the President of the Sheffield Branch of the Institute of British Foundrymen, is the son of Mr. William Whiteley, managing director of one of the oldest cutlery manufacturers in Sheffield. He was educated at Wesley College and King Edward VII School, and commenced his business career at the Deepcar office of Messrs. J. Grayson Lowood & Company, Limited, in about 1909. In 1911 he was transferred to Sheffield, when Mr. F. S. Russell was appointed manager of the Sheffield works, and

MR. ARTHUR WHITELEY.

when Mr. Russell formed the Kelham Island Firebrick Company, Limited, in 1913, Mr. Whiteley was the first man to join him.

Mr. Whiteley joined the Institute of British Foundrymen in 1919. He became the secretary of the Sheffield Branch in 1920, and was elected to the Council in 1928. He is secretary of the new Sub-Committee on Refractories of the Technical Council. Mr. Whiteley is also assistant honorary secretary to the Sheffield Ganister Association and assistant honorary secretary to the Refractories Association of Great Britain, both of which appointments he has held for the last eleven or twelve years.

Calcium Carbide Specification

The British Standards Institution has just issued a new British Standard Specification for carbide of calcium. The specification applies only to carbide of calcium, which is in specified grades and sizes, and as supplied in the original packages as despatched from the factory, which, having regard to the nature of the material can only be applicable when the packages are unbroken and unopened at the time of receipt. The range of standard gradings is specified together with the limits over and under size, and the amount of dust permissible. Limits are laid down for gas yield, scheduled impurities, and the methods for determination of these have been standardised and included in appendices to the specification. The specification also includes detailed descriptions of the methods to be employed for the selection of representative quantities from bulk consignments, and for the preparation of the final samples for testing from the bulk. Copies of this new specification (B.S.S. No. 642-1935) can be obtained from the Publications Department of the British Standards Institution, 28, Victoria Street, London, S.W.1. (Price 5s. 3d. post free.)

The Stability of Nickel

BY "ONLOOKER."

The fluctuations seen during the course of the present year in the prices of those non-ferrous metals which are quoted on the London Metal Exchange have been considerable, the broad trend having been upwards, although recently a somewhat reactionary tendency has been noticeable. So far so good, but at no time in this twelve-months' period has it been possible to say with real confidence that all was well, and that a forward view of, say, four weeks was justified and likely to turn out well. These metals are, of course, traded in a market which is subject to buying and selling orders from all over the world; in fact, much of the business done is speculative, and therefore movements in values are uncertain, and to that extent upsetting to ordinary trading interests. The uncertainty of the price trend in copper must, we imagine, be something of a stumbling block to forward progress by the Development Association, for it is quite obvious that, while the red metal at £30 may be attractive in competition with some rival commodity, a rise of £10 may easily upset all these calculations.

It is in a consideration of this kind that we realise the manifold advantages to industry as a whole when the price of an important commodity is kept at a reasonable fixed level, provided always that the quotation is not such as to exploit consumers. In nickel we have an excellent example of such a commodity, for, although there has been one change in the sterling quotation, viz., from £170 to £200, the price in the States has been stable for ten years at 35 cents per lb. Compare this with a graph of tin and copper price fluctuations from 1926 to 1935, and consider the security which users of nickel enjoy. Is it any wonder that the Bureau of Information on Nickel has been able to push the fortunes of this metal and to secure an ever-broadening basis of consumption? No easy task, for £170 or £200 per ton is a fairly stiff figure at which to lay out money on any commodity, but the task has succeeded, and it only shows that manufacturers and others are prepared to go ahead when they feel sure that the bogey of serious loss through depreciation of stock values is not lurking round the corner to play ducks and drakes with their business.

When the world war came to an end, the nickel producers were faced with a harassing problem, for, with the conclusion of hostilities, the main demand for their product disappeared, and they had to consider what could be done to find new outlets for their metal. That this has been achieved supremely well is shown by the figures of production during the past few years, for from 37,000 tons in 1926 there was a climb to 59,000 tons in 1929, but the trade slump brought a sharp fall to 18,000 tons in 1932. This, however, was the bottom of the curve, and 1934 saw a record output of about 70,000 tons, which will certainly be beaten this year, for demand has been on a remarkable scale, and the producers have been hard pressed to keep pace with it. It may be that there has been some increase in the call for nickel in connection with munitions of war, but, apart from this, commercial demand, very noticeable by the way in the United States, is taking a quantity of nickel. Alloy steel in motor vehicles, nickel silver and many other outlets are now accounting for a very big tonnage every month, and there does not seem to be any likelihood of any falling-away in the near future, while on almost every count an increase may be expected. Well done the nickel producers!

THE GOOLE SHIPBUILDING & REPAIRING COMPANY, LIMITED, have received an order from London owners for a motorship about 140 ft. long.

Recent Developments at the Dagenham Foundry of the Ford Motor Company, Limited*

By VINCENT C. FAULKNER and J. N. BURNS

About twelve months ago the authors detailed in a Paper which they presented to the London Branch of the Institute of British Foundrymen the general lay-out, equipment and processes used at the Dagenham foundry of the Ford Motor Company. It appeared to them desirable, for its repetition before the Lancashire section, to bring this Paper up to date by the inclusion of further data. As was indicated in the original Paper, the general design is such that extensions and modifications can be undertaken without departing from underlying principles.

FIG. 1.—THE 5-TON COKE-OVEN GAS-FIRED FURNACE USED FOR MELTING METAL FOR CRANKSHAFT CASTINGS.

Primarily, it should be stated that the previous description was somewhat incomplete, as the Paper terminated when the fettled castings were attached to a chain conveyor which fed the machine shops. Actually, before removal of the castings, they are passed through a tank filled with hot soda solution, and then through a second one containing hot water. A periodical examination of the sludge accumulating within these tanks gives a very precise measure of the efficiency of fettling processes, besides giving one more assurance to the user of the meticulous care used in the fabrication of Ford castings.

Rotary Melting Furnaces

The previous article rather sketchily referred to a then recent installation of a coke-oven gas-fired furnace of 5 tons capacity. This furnace has been such a success that a second unit has been installed, the combined plant being used for the provision of metal for the manufacture of malleable cast iron and cast crank and cam shafts. The plant is largely running on the duplex system, taking liquid metal from the cupola. Thus, the rotary furnace is used for compositional adjustment and superheating. The lining is lasting between 80 and 100 heats. It is prepared by ramming plastic refractory around a former and subsequently drying very slowly. The preparation of the refractory involves a prolonged mixing and soaking in order to ensure that the moisture content is constant throughout the mass. The refractory, which is compressed by pneumatic rammers, is piled up against the internal former and sloped away towards the steel casing. By this method the material which will later be in contact with the liquid metal will be more highly compressed than the material adjacent to the casing. By this means, expansion is largely and successfully provided for.

The duplexing method is employed in the manufacture of malleable, and is briefly this:—The necessary cold charges are put through a 5-ton per hr. cupola and the molten metal is run off into a forehearth to ensure that there is a minimum carbon pick-up from the coke bed. The metal is then transferred from the forehearth to the rotary furnace and superheated for one hour. During this period the furnace atmosphere is so controlled that a definite carbon reduction of the metal is obtained in addition to the effect of superheating. The metal is then tapped into ½-ton ladles for disposition to the mould conveyors. Whilst No. 1 furnace is pouring, No. 2 furnace is being superheated, so that practically a continuous supply of metal is available to the moulding lines. All malleable back-scrap is absorbed in the cupola charges, and no cold charges are made in the rotary furnace.

Crankshafts—Melting

Crankshaft iron is melted from the cold charge, consisting of approximately 50 per cent. back-scrap, 35 per cent. pig-iron and 15 per cent. steel, the melting and superheating time in the rotary furnace is approximately 3 hrs. from cold. After bath sampling, the metal is tapped into 1-ton ladles and conveyed by overhead monorail to the moulding lines, where the moulds are poured direct from this ladle.

Moulding

Three types of crankshafts are now in regular production, *i.e.*, 8-h.p. Popular, the V-8 and the tractor crankshaft. The tractor crankshaft is moulded in green sand, whilst the moulds for the two other types are constructed of baked oil-sand cores. For the 8-h.p. model thirteen cores are used and for the V-8 sixteen cores. The different core boxes are mounted on a carriage-type conveyor, and pass under the head of a fixed Sandslinger; here the cores are rammed and then pass on to be strickled, rolled over and stripped on a drying plate. The cores are then baked in a vertical-type core oven, and on emerging from the oven are placed on another carriage-type conveyor. Here the moulds are sprayed with a special silica wash to counteract the erosive effect of the superheated molten iron; the cores are then carefully gauged for size. Close accuracy in the manufacture of these cores is essential in order to avoid the accumulative

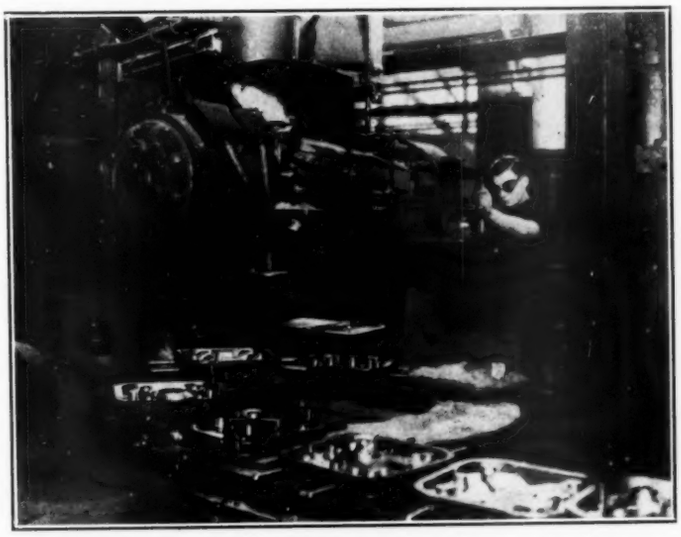

FIG. 2.—A SANDSLINGER RAMS UP METAL CORE BOXES.

* An appendix to a Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. J. Jackson presiding. The Paper was originally published in the FOUNDRY TRADE JOURNAL, Vol. LI, p. 235, *et seq.*

effect of error in the final build-up of the cores. After the cores have been gauge inspected they are placed on a continuous overhead pendulum-type conveyor, a complete set of cores being carried on each pendulum. This pendulum conveyor carries the moulds to the final pouring conveyor, where the moulds are assembled on the mould-carrier plates and clamped in position by means of hinged castings, which also act as mould-top plates and pouring heads. After pouring, the moulds are conveyed to shakeout where the castings are stripped and hung on an overhead cooling conveyor, which delivers the crankshafts through a continuous shot-blast cabinet and finally to a special double-deck gas-fired heat-treatment furnace.

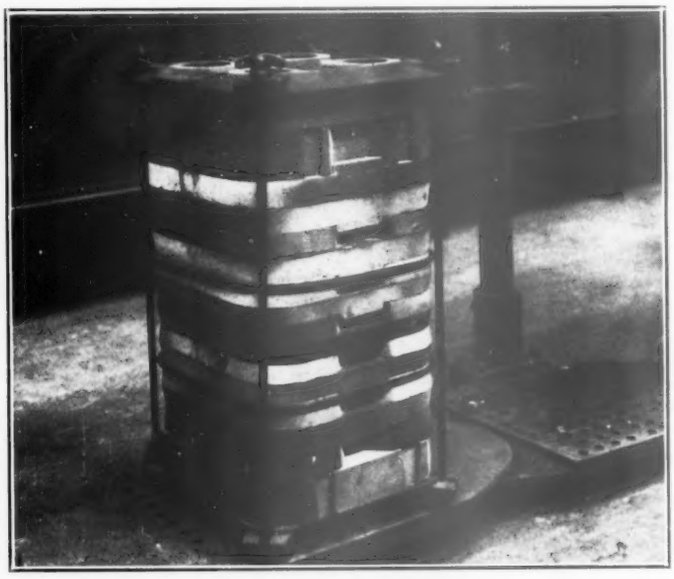

FIG. 3.—SHOWS THE METHOD OF ASSEMBLING THE CORES TO MAKE A COMPLETE MOULD..

The castings are moulded in the vertical position and a central runner of ample dimensions runs down the centre of the mould and feeds through ingates at the base and half-way up the castings. This method was found after a great deal of research to be the only method of preventing distortion of the finished crank during the cooling and also overcome many other practical difficulties of manufacture.

Malleable Moulding

It is interesting to note that the Ford Motor Company, Limited, has succeeded in establishing what is probably the first successful continuous malleable foundry. The handling of the sand, making of the moulds, setting of the cores, and the continuous pouring is carried out exactly in the same manner as on the grey-iron moulding systems. This system enables some 30 tons of malleable per day to be produced in a space of approximately 10 ft. wide by 250 ft. long. A synthetic sand is used in the moulding system and the following properties are maintained:—

	Vent.	Bond.	Moisture.
Back sand ..	90	6 to 7	4.0
Facing sand ..	90	9	3.4

Fettling Department

This department is at the moment undergoing drastic revision necessitated by increased production and improvement in fettling methods. In the new system the castings, after being cooled on the cooling conveyor, will be delivered to a line of some eighteen 72-in. by 42-in. tumblers and three large airless shot-blast cabinets complete with automatic loading and unloading devices. The large intricate castings are taken through a large continuous shot-blast cabinet where special care is taken to free from all traces of sand and other matter which might be dislodged during normal use of the engine and all cleaning is done by chilled-iron shot, which precludes silica grains becoming embedded in the surface of the metal. After the preliminary cleaning all castings will be delivered on to individual slat conveyors and removed at various stations for grinding and then returned on the conveyor for final clean-up, water test and inspection. At the end of the slat conveyors the castings are removed and placed on continuous overhead chain conveyor which feeds the various machine lines and also acts as a mobile storage system.

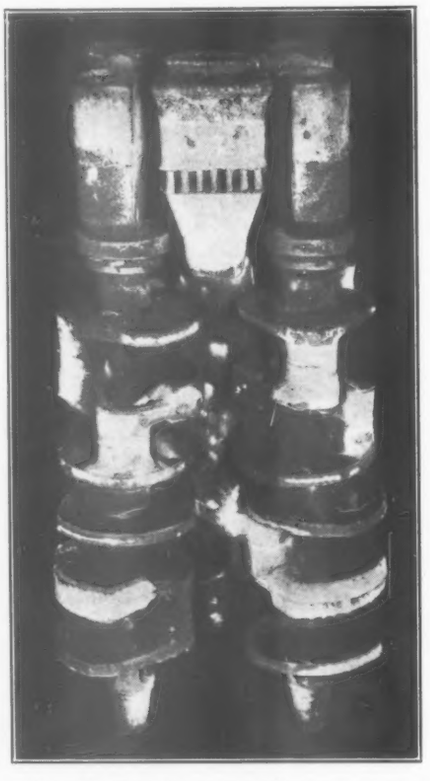

FIG. 5.—THE CRANKSHAFT CASTING AS IT LEAVES THE MOULD, SHOWING FEEDING ARRANGEMENTS.

Conclusions

The story of the Ford foundries will never be adequately told, as the ceaseless striving after metallurgical and physical perfection leaves them always in a state of flux, but never for a moment is the golden rule of orderliness and cleanliness violated and neither is production held up.

Mould and Core Materials at Elevated Temperatures

(*Concluded from page* 470.)

expansion at 1,000 deg. C. using the law of Gay-Lussac. Unfortunately, the theoretical results obtained were nowhere near actual practice. After wasting a good deal of time, I came to the very definite conclusion that Gay-Lussac's law cannot be applied under the conditions adopted in my Paper. You will appreciate that even the moisture in the air is sufficient to upset Gay-Lussac's law when temperatures are employed of a degree sufficient to transform moisture into steam. In view of these variables, we decided not to employ the theoretical calculation, but to obtain a definite practical result by passing the air through a hot-silica tube such as outlined in the Paper and as recorded in Fig. 4. We also considered the idea of reheating the air up to the required temperature and passing the hot air through, as you suggest, but found that the control and measurement of this hot air was so difficult as to prevent its adoption. When all is said and done, the results given in the Paper come back to your argument, for, instead of passing 2,000 c.c. of hot air, we employed 2,000 c.c. of cold air, but by the previous determination of its expansion we can readily calculate the effect of 2,000 c.c. of hot air. Furthermore, I would remind you that when you pass hot air through a core containing combustible matter, although you may have measured the air very accurately, this measurement is of no value, due to the fact that the combustible matter in the core gasifies, and this upsets all your calculations.

Further Suggestions Covering Costs in the Melting and Moulding Departments of a Grey-Iron Foundry

(*Concluded from page* 468.)

ings, made with dry-sand moulds on a moulding machine, the overhead applying to all sections of the foundry will be 80 per cent. of direct wages charged to the job, plus 15 per cent. for the moulding machines, plus 25 per cent. for the drying ovens; therefore, the percentage overhead for this job will be 120 per cent. of direct wages. We have:—

	£ s. d.
Cost of metal at the spout, per ton of good castings (obtained from Melting Department, mixture A, class II)	– – –
Direct costs—	£ s. d.
Direct labour	– – – (A)
Patterns, cores, boxes, etc.	– – –
Overhead—120 per cent. of A..	– – –
Total cost	£– – – (C)

Dividing C by the tonnage of good castings produced, it yields the cost per ton of good castings for the Moulding Department.

£– – –

This gives the cost per ton of the job up to the point where it leaves the moulding department.

The report is signed by Mr. V. Delport, the convenor of the Sub-Committee.

EIGHT ELECTRIC LOCOMOTIVES have been ordered by the Government railways in New Zealand from the English Electric Company, Limited, according to a message from Wellington.

Further Suggestions Covering Costs in the Melting and Moulding Departments of a Grey-Iron Foundry

By the Costing Sub-Committee of the Institute of British Foundrymen

Introduction

The discussions that followed the reading of our first Paper on melting costs, before the Branches of the Institute last winter, were of great assistance to this Committee. The remarks and criticisms that were made at the meetings and in correspondence enabled us more thoroughly to investigate certain aspects of the problem, and to arrive at definite conclusions. We hope that the same assistance will be given to us in respect of costs in the moulding department, which are the main subject of this Paper. We are particularly anxious that members should draw our attention to any point that we may have overlooked. It is by active co-operation of all members interested in the subject of costing that we can hope to arrive at a successful end of our work.

Before dealing with the subject of moulding costs, we wish briefly to summarise the changes that have been made to our original Paper on melting costs as a result of the discussions that followed its presentation. With the exception of the valuation of home scrap, only minor changes have been made.

Our latest recommendations on melting costs were embodied in a report that was displayed at the Technical Section of the Foundry Exhibition at Olympia last September. It is mainly from that report that the following extracts are taken:—

First of all, we wish to stress two fundamental principles, which perhaps were not sufficiently emphasised in the first Paper, and which will apply all through the system:—

(*a*) Wherever possible, *an expense incurred for a job should be charged to that job*; in other words, it is not fair that a job should be charged with costs pertaining to another job.

(*b*) *The works should be divided into a number of departments*, and, where a variety of castings is made, *the foundry should be divided into a number of sections* corresponding to the various classes of castings made.

These divisions enable the various factors of expenditure to be allocated in such a way that each class of castings will bear its proper cost in conformity with principle (*a*). The division into departments and sections will be more or less extended in accordance with the circumstances of each undertaking. The purpose of this system is *to establish uniform principles of costing*. The details of their application to individual undertakings must be adapted to the circumstances of each case by the management. In every case, the proper keeping of the necessary records of stocks, weights of materials charged, weights of castings, scrap, etc., and of wages, is of primary importance.

MELTING COSTS

Cost of Metal

Dealing now with the method of arriving at the "cost of the metal at the spout per ton of good castings produced," as indicated in our first Paper, we have added a recommendation in respect of alloy additions, to the effect that "the total cost of the alloys should be charged to the job, except when the alloy scrap can be used again for a similar type of casting, in which case an allowance should be made, proportionate to the value of alloy present." This provision is entirely in conformity with the fundamental principle established under paragraph (*a*).

Coming to the question of home scrap, we are confirmed in our opinion that the cost value of home scrap, as a constituent of a metal mixture, can be determined precisely. We have very carefully investigated the problem with a view to arriving at a simple solution, yet one that would be as nearly correct as possible.

We recommend, therefore, that "the cost of home scrap in a given mixture charged into the cupola be the average (mean) cost of the pig-iron and bought scrap that go into the charge, in the proportion in which they are charged—or, in other words, the same as the cost of the purchased metal going into the charge."

For instance, if a mixture consists of:—

1 ton pig-iron at £3 15s.
½ ton bought scrap at £2 15s.
½ ton domestic scrap.

the mean price of purchased metal in that mixture is:—

	£	s.	d.
1 ton at £3 15s.	3	15	0
½ ton at £2 15s.	1	7	6
	£5	2	6

(equal to £3 8s. 4d. per ton).

That figure will be taken as the cost value of the home scrap, and we shall have:—

	£	s.	d.
1 ton pig-iron at £3 15s.	3	15	0
½ ton bought scrap at £2 15s.	1	7	6
½ ton home scrap at £3 8s. 4d.	1	14	2
	£6	16	8

(equal to £3 8s. 4d. per ton of metal mixture).

In allowing for returned scrap from that melt, the same figure will be used. This is a simple method, and, if it is accepted as a standard, it will ensure uniformity.

We have added a paragraph to the section on Metal Costs, namely, that "Metal costs should be divided as between the various mixtures that may be used in the foundry. Scrap returned from these mixtures should be stocked separately and used only in conjunction with the mixture from which it originates: this is particularly important in the case of mixtures containing alloys."

Cost of Melting

To this section of the original Paper we have added the following paragraph:—"Whether the yield of 'good castings' produced is large or small, melting costs are incurred for all the metal melted. Melting costs should, therefore, be divided so as to distinguish between heavy castings and light castings on the basis of the proportion of good castings to metal melted; castings should be classified accordingly, and each class costed separately. The number of classes depends upon the conditions of each undertaking."

Oncosts

The following paragraph has been added to this section:—

"Departmental oncosts and fixed charges are to be allocated to the various classes of castings in the same way as melting costs."

Application of the System

Cost of Metal.—For each mixture the cost of metal is calculated as follows:—

	Mixture A.
Pig-iron (*a*) *x*1 cwts. ..	Price as per inventory.
,, (*b*) *x*2 ,, ..	,, ,,
Bought scrap *y* ,, ..	,, ,,
Home scrap *z* ,, ..	Mean price of above.
	£ s. d.
Total cost of mixture.. ..	– – –
Less scrap returned (at price of mixture)	– – –
Cost of metal going into good castings	£– – – (A)
Tonnage of good castings produced (*x* per cent. of total melt)	X cwts.
Cost of metal per ton of good castings produced	$\frac{A}{X}$ £– – –

Metal loss (for reference—*y* per cent. of total melt).

Cost of Melting and Oncost.—The various items of cost of melting and oncost are added up for a period of costing, as follow:—

Labour, charging	Wages book.
Coke, limestone	Price as per inventory.
Plant maintenance and repairs (labour and materials) ..	At cost.
Ganister, supplies	Price as per inventory.
Loose plant	At cost.
Supervision	Pay roll.
Light, power	Measured or estimated.
Share of fixed charges (rent, rates, depreciation, etc.) ..	Allocated on floor space.
X	
Y	
Z	
Total	£– – – (B)

The castings are divided into classes corresponding to the yields of good castings to metal melted. As the melting costs and oncost increase in proportion to the tonnage of metal melted, the total amount of these items of cost should be divided between each class of castings proportionately to the tonnage of metal melted in each class: it is then a simple matter to divide the melting costs and oncost in each class by the tonnage of good castings produced in each class, and arrive at a cost per ton of good castings produced.

If a certain job is made from mixture A and comes under class II (50 to 60 per cent. yield of good castings to metal melted), the cost per ton of the metal mixture A is added to melting costs and oncost per ton pertaining to class II, and the result gives "the cost of the metal at the spout per ton of good castings produced" for the job.

COSTS IN THE MOULDING DEPARTMENT

Direct Costs

Direct costs are those which can be charged specifically to a job. In order to conform with our first fundamental principle, namely, that "an expense incurred for a job should be charged to that job," we should aim at bringing in as much as possible under the heading of "Direct Costs." Having arrived at the cost per ton of our metal at the spout, we are able to apply this as a direct cost per ton, cwt. or lb. to all castings made.

Other items which must be considered under this heading are: Labour, Moulding Boxes, Patterns, Cores, Tackle, and certain materials wherever it is possible that such materials can be charged direct to the job.

In order to apply the principle that wherever possible costs should be applied direct to their specific job, each job should be timed so that the correct amount of direct labour costs can be charged to the job.

Furthermore, in order to be able to apply the correct share of overhead costs to each job, cast-

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ings should be classified in the Moulding Department in accordance with the method of preparing the mould; therefore, a distinction should be made between machine-made moulds, hand-made moulds, loam moulding, dry-sand moulds, green-sand moulds, and there should be corresponding divisions in direct labour costs when making up the periodical cost sheets.

Moulding Boxes.—In accordance with one of the fundamental principles of the system, whenever moulding boxes are made for a specific job, their actual cost must be considered as a direct charge against that particular job.

Any other boxes, purchased or made in the foundry and used for general purposes—that is to say, those that are not used for a specific job—should be debited at cost to a "Box Part Account." This account should be liberally depreciated and the depreciation charged to the Moulding Department as a departmental overhead. This account should be credited with the scrap value of discarded boxes at the time they are scrapped.

Foundry tackle is treated in the same way: when made for a specific job, it is charged to the job; when made for general purposes, it is debited to a special account and liberally depreciated.

Patterns.—The same principles apply to patterns as those established for moulding boxes: patterns made for a specific job should be charged against the job. The method of establishing pattern cost will be explained in a special section dealing with the Patternshop considered as an auxiliary department.

Cores.—Cores are obviously a direct charge against each job. The method of establishing core costs will be arrived at when we next deal with the Core Department.

Materials, including chaplets, screws, nuts, hinge-plates, etc., should, whenever possible, constitute a direct cost against the job. When this can be done, such materials should be the subject of a Stores issue, against an identification such as an order number, which ensures their direct charge to the specific job.

Indirect Costs

This section covers costs which, by their very nature, cannot be ascribed directly to any particular job. Indirect costs comprise:—Indirect labour, moulding sand, miscellaneous supplies and tools, repairs, etc., and a share of general overhead expenses. As many separate accounts as possible should be kept, in order to enable costs to be properly analysed. A list of such items is given at the end of this Paper.

Indirect Labour.—This account covers the wages of all labour employed in the Moulding Department that cannot be accounted for under the heading of "Direct Labour": it includes the wages of men occupied in the sand-mixing and sand-reclaiming plant, the wages of men in charge of mould-drying ovens, the wages of men in charge of repairs. The wages of men whose duties are divided between the moulding and another department should be divided in proportion to the time spent in each department.

Moulding Sand.—New moulding sand is included in this account. Labour employed in the sand-preparation plant for reclaiming used sand, also depreciation and maintenance of sand plant, are to be charged to the Moulding Department in the Departmental Overhead account. In some cases the sand-preparation plant can be considered as an auxiliary department, the total cost of which is charged as a departmental overhead of the Moulding Department: this procedure enables a better control of the cost and efficiency of the sand-preparing plant to be effected.

Miscellaneous Supplies and Tools.—In general, the cost of plumbago, blackings, etc., and loose tools should be spread over the Moulding Department. In foundries that are divided into separate sections, these costs should be allocated between the various sections, bearing in mind the general principle that "a charge incurred for a job should be a direct charge against the job": for instance, spare parts or tools used specifically in conjunction with moulding machines should be charged to the machine-moulding section. Special tools used for loam moulding should be charged to that section. In accordance with the same fundamental principle, fuel used in the mould-drying ovens should be a charge against the Dry-sand Moulding section; also maintenance and depreciation of the ovens. Again, as far as possible, screws, nuts, hinge-plates, etc., should be charged against the job for which they are used. The safest way to ensure that all such supplies are accounted for is to charge them against the Moulding Department at the time they are issued from stock, and a proper system of stores issuing and accounting, with direct charging wherever possible, should be instituted.

Repairs.—Unless men are fully employed in doing repair jobs, labour costs for repairs are included under the general heading of "Indirect Labour." All materials and spare parts used in the repair of moulding equipment and of ladles are to be charged as a departmental overhead against the moulding department, or its various sections, *pro rata*. In the larger undertakings, repairs and maintenance of plant and equipment may constitute a separate auxiliary department; in such cases the costs of this auxiliary department are divided and allocated to the four main departments and their respective sub-sections as departmental overheads.

Foremen, Clerks, etc.—In those undertakings where a number of foremen and clerks are fully employed in the moulding department, their salaries constitute a departmental overhead.

Heat, Light and Power.—These items of expenditure can be measured or closely estimated in proportion to their utilisation by the various sections of the moulding department. Heat and light can be allocated on a floor basis; power can be allocated on the basis of consumption of the various plants utilising power. This is a departmental overhead. In those undertakings which operate their own power plant, these items constitute an auxiliary department, in which the cost per unit of the medium of power can be determined. This cost is then allocated on the basis established in the preceding paragraph.

Fixed Charges.—These include rent, rates, taxes, depreciation of buildings and plant, insurance, etc. For buildings a departmental factor can be worked out on a floor basis. Depreciation of plant and equipment should be computed on the basis of value and probable life of each kind and type of plant. Rent, rates and taxes are worked out on a floor basis.

An allocation should be made at the beginning of each year for each department or section of the undertaking. All items of general expense that can be definitely allocated to the moulding department should be so charged. Such items of general expense that cannot be divided between the various departments of the undertaking, such as administration expenses, social charges, selling costs, outward freight, financial charges, bad debts, etc., will be dealt with at a later stage.

Method of Allocating Overheads in the Moulding Department.—The various methods of allocation, on the basis of direct wages, time, space and tonnage, were considered and compared at length at several meetings of the Sub-Committee and discussed by correspondence. It has been found that the simplest and soundest method applying to the average-size foundry is that based on direct labour. This method is open to some criticism in certain cases, but so are all the other methods. The Sub-Committee has ruled out the tonnage basis as definitely unsound; the space and space-time methods have been found too complicated and open to objections.

In certain cases the time method would be acceptable, but it has been found that for the majority of cases, and in view of the fact that *in any case* wages must be accurately recorded, the direct labour method has been found the best to adopt for a uniform system, and the one least likely to offer the risk of inaccuracies and complications.

This Sub-Committee therefore recommends that overhead charges in the moulding department be computed on the basis of *direct labour*. It cannot offer recommendations applying to widely exceptional cases, except that the fundamental principles of this system should be applied, but that their detailed application should be adapted to the circumstances of the case and governed by common sense.

Application of the System

The following is a list of certain current items of cost that make up the overhead expenses relating to the moulding department. This list is not exhaustive, and should be modified in accordance with the circumstances of each undertaking; it is given merely as a guide. Certain headings, such as box parts, foundry tackle, materials ex-stores, are included to cover those items that could not be charged as direct costs.

Labour, unproductive—
Wages. Salaries. Stores. Packers.
Box parts—
Labour. Materials.
Foundry tackle—
Labour. Materials.
Sand—
Labour. Materials.
(Or cost of Sand Preparation Auxiliary Dept.)
Drying ovens, labour and materials.
Materials ex-stores.
Coal dust.
Moulding machines, repairs, labour and materials.
Plant repairs, labour and materials.
Salaries.
Coal and gas.
Power and light.
Carting.
Workmen's Compensation Insurance.
National Health Insurance.
Unemployment Insurance.
Boiler-house wages.
,, materials.
Laboratory wages and salaries.
,, materials.
Rent and rates.
Depreciation of boxes.
,, ,, fixed and movable plant, etc.

Those items that can be allocated to a particular section of the foundry should be extracted from this list and allocated to the proper section; for instance, the cost relative to drying ovens, including fuel, should be charged to the dry-sand-mould section; repair and depreciation of moulding machines should be charged to the machine-moulding section; tools used for loam moulding should be charged to the loam-moulding section, etc.

All the other items that apply to all sections of the foundry are then added up. The ratio of the total amount to direct labour costs in the moulding department is taken. In each section of the foundry, the ratio of overheads specifically charged to that section to direct labour costs in that section is also taken.

For instance, if total direct wages in the moulding department during a costing period amount to £200, and all items of indirect cost applying to all sections of the foundry total £160, the percentage to apply to direct labour costs to cover overheads is 80 per cent., or for each 20s. of direct labour, 16s. should be added. If direct wages in the dry-mould section amount to £120 and the overhead applying specifically to that section amounts to £30, 25 per cent. of that section's direct labour costs should be added further, or 5s. for every £1. In the same way, the moulding-machine overhead might be 15 per cent.

Applying this to a job made from mixture A, yielding from 50 to 60 per cent. of good cast-

(*Concluded on page* 466.)

Mould and Core Materials at Elevated Temperatures

DISCUSSION AT DERBY

Mr. Frank Hudson's Paper, which was printed in our issue of December 5, 1935, received, as it well deserved, an excellent reception. The discussion was opened by MR. S. H. RUSSELL, a Past-President of the Institute, who, after thanking the author, said some of the results had surprised him; others explained things he had known to happen, but had not been able to give a reason for their occurrence. He asked whether Mr. Hudson would explain what was meant by "Scottish Rotten Rock," as he was afraid that the term was unknown in the Midlands district. He noticed that the mixture for green sand in the ironfoundry was principally used sand. To the ordinary foundryman, the numerous curves explained many things noticed in practice, but seldom appreciated. All had noticed how air rushed out of the vents and had heard the peculiar noises caused by restricted vents. It was obvious to all that the volume of cold air in the mould could not be responsible for producing the noises made by the rush of air through the vents. The results shown on the test-cores did not show a point he had noticed in ordinary practice. He referred to the issue from the mould joint of a liquid. One could see a "gummy liquid," and it was fairly certain to assume that would tend to block the pores and cause vent restriction. He had noticed that the strength of sand containing coal dust did not rise when heated. Could Mr. Hudson give any theory why that was so, because in most foundries, particularly when using sand over and over again, coal dust would be persistent through the mixture? He was reminded of a period when he had to overcome "pitting" troubles; he used only a fine grade of coal dust, and it took six months to eliminate the coarse coal dust in the old sand, although using 25 per cent. of new sand in the mixture.

Scottish Rotten Rock

MR. HUDSON replied that perhaps he should have explained that "Scottish Rotten Rock" was a very strongly-bonded sand, similar to that known in the Midlands as "York Yellow," etc. Similar results could be obtained with Bentonite, but the amount of Bentonite he would have to use in the mix would be about one-sixteenth of 1 per cent., which was impracticable. He had to resort to a material with lower bond than Bentonite, but greater bond than the average moulding sand. The sands as shown were used for the tests, but to supplement the results he had obtained samples from other foundries, and the actual mixture type did not make much difference. If he used 98 per cent. old sand, and another 50 per cent., the results obtained were identical so far as the present investigation was concerned. With regard to the condensation of volatile matter, that could not happen in the laboratory tests, as the sand and tubes were at high temperature. In practice, Mr. Russell's theory would apply, as the mould surface was hot, and farther back the mould was cold. This would cause condensation, and probably reduce the permeability. His theory on the effect of coal dust could probably be explained as follows:—He assumed it was due to carbonaceous matter, so he had tried blacking and crushed coke breeze, and had thought he would get similar results as when using coal dust, but it was not so. Blacking did not prevent the rise in strength. Fifty per cent. breeze and clay gave no reduction in strength. Coal dust gives the reduction in strength, and this is probably due to the volatile matter present.

The metal, on heating the sand to temperature, caused a miniature explosion, due to the condition of the volatile matter in the coal dust, which shattered the bond and so caused the reduction of strength. One should, when adding coal dust, use a fine grade.

The Question of Silt

MR. S. H. RUSSELL then asked how Mr. Hudson disposed of the silt in the sand.

MR. HUDSON said his theory of silt, so far as the ironfounder was concerned, was that it just did not form. It was put there by the foundryman. He had run for three years on his present mixture, and sieve tests were taken every week, which indicated that the silt was at least 40 per cent. lower than two years ago, and probably 50 to 60 per cent. lower than three years ago, when ordinary facing sand was used. Excess silt indicated uneconomic use of new sand.

Coal Dust Replacement

MR. T. GOODWIN said the author's mixture showed 0.3 per cent. coal dust. What was the total percentage of coal dust in the mixture. Also, what was the reason for addition of wood extract to the mixture?

MR. HUDSON said that, as Mr. Russell had indicated, one could not get rid of coal dust, and he had found that 0.3 per cent. was all that was required to replace that burnt out. He maintained a figure of 10 per cent. coal dust by a batch addition of 0.3 per cent. The reason for the use of wood extract was as follows:—To obtain good castings the two important factors were green-bond strength and dry-compression strength. He had found that to get satisfactory castings he must have a green bond of 4 to 6 lbs. per sq. in., and he did not like the dried strength to fall below 50 lbs. per sq. in. The amount of new sand added was only sufficient to bring up the green bond. If he had to rely on new sand additions, the amount to be added to give the specified dried strength would bring the green bond too high. He added wood extract to get the correct dried strength, and in that way he was able to get the properties right.

Silt Problem

MR. F. BUTTERS asked the weight of the castings being produced in the green-sand mixture, as he thought the silt question depended largely on the type and weight of castings being produced.

MR. HUDSON said the green-sand mixture was used on castings up to 10 cwts. in weight, but he pointed out that he had also given a dry-sand mixture with 98 per cent. old sand, which was used for castings up to 20 tons weight. He could not find any increase in silt, even with this sand. The dry-sand mixture was lower in silt than a year ago, and he did not have any large percentage of casting defects that could be attributed to the sand.

MR. H. BUNTING said the lecture had given a new line of thought, and asked whether the expansion of the sand gave a permanent growth to the grains, or did it decrease as the sand cooled off? Mr. Hudson had mentioned that an ideal sand would be one that would give a lesser degree of artificial venting. He (Mr. Bunting) was of the opinion there were more waster castings through the lack of understanding of venting than any other cause. Many moulders, in fact he would go so far as to say the majority, did not understand the idea of venting. Could Mr. Hudson give them a sand that would require no artificial venting?

Seeking a Common Denominator

MR. HUDSON said the main object of his Paper was to give an idea of what was happening. He would say that in reality this was only half a Paper, the remainder to be published at some later date. Perhaps in the second part he would be able to tell Mr. Bunting how to make that foolproof sand, but he did not know at present. One would probably still have to rely on getting the excess air and gas away through some artificial channel. For the present, he had stopped attempting to decrease the permeability any further. In the course of collecting data for the Institute's Sand Sub-committee he had examined sands from all over the country, and was amazed at the variation of the properties of sands. He had seen large castings made in sands that were similar to those used in a light stove-grate foundry. One firm making large castings had a permeability figure of 200, and a firm making similar work had a permeability figure of only 25, and they both made good castings, but handled their sands in a different manner. The low-permeability sand was used with artificial vents and risers. Furthermore, where the sand had a low permeability number the workmen were trained to ram lighter. That was where the skill entered. At one time he thought he could produce a completely foolproof sand, but he had now nearly given up that idea.

Gas Expansion

MR. P. A. RUSSELL said it was disturbing to find that Mr. Hudson was saying that the expansion of gas did not conform to the normal physical law, and he thought it would be interesting to see a theoretical curve; he thought it would add to the value of the Paper if that point was elaborated. Mr. Russell admitted that the evidence as to the action of coal dust was conclusive, and also that Mr. Hudson's theories were possible, but more possible in the mould than in the experiments. Did Mr. Hudson intend to indicate these explosions take place at a certain temperature, say, for example, 400 deg. C.? In that case, one would not expect increase in strength up to the point of the explosion. Referring to silt, it was possible to be misled. His firm were using clay-bonded sands, and he understood that it was from clay that silt came, and it was never possible to eliminate silt.

Silt Reduction

MR. HUDSON said the point of theoretical calculation had already been taken up strongly. Mr. T. R. Walker, of Sheffield, had supplied him with steelfoundry compo for the tests, and he had seen the results and had raised the same point. He (Mr. Hudson) thought it better to do the work in a practical manner instead of by theoretical calculation. In his test, using the Richardson permeability apparatus, the air was passed through, due to displacement of water. He was not clear whether he was getting small particles of moisture going through with the air. If it existed as water vapour, the law should still apply, but not if one had fine particles of water held in suspension. He had thought it advisable to adhere to practical conditions, as far as possible. There was possibility of climatic conditions requiring consideration; for example, fog might drift into the shop. Could fog be classed as a perfect gas? It was suggested that he should heat up the air to 1,000 deg. C. and pass it through the specimen, but it was difficult to pass hot air and control it. Furthermore, as all sands contain carbonaceous matter, he thought he would get CO and CO_2 coming out, which would increase the expansion due to heat alone, and this was not adequately taken care of in theoretical calculations.

With regard to artificially-bonded sand and the silt question, he did not think the foundry need utilise artificial sand to prevent the formation of silt. He thought intelligent sand

control would go a long way to prevent the formation of silt. The average foundry used a too-heavily-bonded sand. The clay grains, so far as size is concerned, come into the silt classification, and one can only distribute a certain amount of clay around a silica grain. If one had too much clay, it reduced permeability and caused a large percentage of fines. If every foundry put in sand control and made tests, they would be in a position to reduce silt by using a sand with lower green strength. He was convinced the solution of the silt problem was systematic sand control.

MR. H. SANDERS asked what was the amount of new sand used per ton of castings produced.

MR. HUDSON replied that the figure was approximately 0.03 to 0.06 tons of new sand per ton of castings.

MR. J. F. DRIVER (Branch-President) asked whether the viscosity of the air at high temperature had anything to do with permeability figures. Also, he thought Mr. Hudson had not answered Mr. Bunting's query as to whether growth of sand grains was permanent, and he also was interested to hear the answer to that question.

MR. HUDSON said he could not say anything about viscosity of air. That was a point he had not considered in the tests. He apologised for omitting Mr. Bunting's question. The expansion on sand grains was not completely permanent, but partly so. Silica goes through changes, and they are dependent on time and temperature. Theoretically, if silica sand was heated up to 1,000 deg. C., there would be a change at about 870 deg. C. His tests had indicated a partial reduction in expansion after cooling, but not complete.

Vote of Thanks

MR. A. E. PEACE, in voicing the thanks of the meeting, said it was not necessary for him to stress the excellence of the Paper, as that had been done so well by those taking part in the discussion. It might be of interest in connection with the amount of new sand, that he was recently in a foundry where they literally used no new sand, but in particular, green sand, which was made from burnt core sand. Whether that foundry were influenced by the facts of preheating, he did not know. There was one question he would like to raise, and that was whether the degree of ramming for the test-pieces was similar to foundry practice.

The vote of thanks was received with applause.

MR. HUDSON expressed his appreciation, and said he got a good deal of pleasure in coming down to give the Paper. Before replying to Mr. Peace, he would like to make a further remark in regard to Mr. Bunting's question of a foolproof sand. This was the effect of mould and core facings on permeability. Some tests he had conducted for dry sand and oil sand showed the average blackwash completely sealed the pores. A test-piece might give a figure of 200 A.F.A. permeability, but after blackwashing the permeability would drop to a figure of 6. What was the use of a permeable sand if one coated it with a wash that was impervious? In reply to Mr. Peace, all test-pieces were rammed to a density to correspond with their normal practice.

GAY-LUSSAC'S LAW

Written Contribution

MR. T. R. WALKER wrote:—I have been looking through your Paper and find myself unable to follow your reasoning and remarks regarding the increase in volume of air on heating. For instance, you state that "2,000 cc. of air at normal temperature and pressure" (by which I understand the temperature of 0 deg. C. and 760 mm. pressure) becomes nearly 6,000 cc. at 500 deg. C. and nearly 15,000 cc. at 1,000 deg. C.

Actually, air at constant pressure expands by $\frac{1}{273}$ of its volume at 0 deg. C. for each degree rise in temperature, so that at 1,092 deg. C. its volume will be 10,000 cc. against your 15,000. The expansion of air at constant pressure is at a constant rate, and, therefore, gives a straight-line graph, so that I do not quite see how you obtain the kinks shown in Fig. 4. I presume the explanation is bound up with the fact that you start with 2,000 cc. of air at ordinary temperatures and that as soon as you start passing it through the specimen it expands considerably, so that by the time 2,000 cc. of hot air has passed through the specimen there is still a good deal of the original cold 2,000 cc. left. It seems to me, however, that the only logical way of dealing with this is to heat the original air up to the same temperature as the test-piece and pass 2,000 cc. of this air through the specimen.

The AUTHOR then replied:—In regard to my remarks about Gay-Lussac's Law it should be understood that it is not my intention to dispute its validity except so far as the issues in my Paper are concerned. Under carefully controlled laboratory conditions the Law may be correct, but under the practical foundry conditions which my Paper is intended to represent, it cannot be accepted without reservations. I would consider that Gay-Lussac's Law is correct for a perfect gas. Unfortunately, under foundry conditions there are so many variable factors which upset Gay-Lussac's Law. Taking the effect of moisture in the air, you assume that the moisture exists entirely as water vapour. No doubt it does in the normal atmosphere. You do at times, however, get the moisture existing in the finely-divided liquid form. When this condition arises the water will be changed into steam as soon as 100 deg. C. is exceeded, with the consequent formation of a material having 1,600 times greater volume. Using Richardson's permeability apparatus, it is debatable as to whether or not the air being passed through the heated specimen contains water vapour or water particles in suspension. If the air contains any liquid-water particles it is perfectly obvious that this will effect Gay-Lussac's Law, and this was one of the reasons why we preferred to adopt the fine-bored silica-tube method for the determination of expansion rather than calculation.

Similarly, in regard to carbonaceous matter, the test specimen is being heated with a limited supply of oxygen, insufficient to cause a full gaseous reaction. However, when the air is blown through, excess oxygen is supplied which enables the combustible matter to react readily and form gaseous products of large volume. In regard to your query as to the heating time, it might have been mentioned that the total time to reach 1,000 deg. C. was about 5 hrs., giving an average of 30 min. time interval for each 100 deg. C. rise in temperature, 10 min. of this being spent maintaining the temperature at each test-point. As a matter of fact we conducted preliminary tests to ensure that heating was carried through to the centre of the specimen, and the above schedule was found to be satisfactory.

I am not in favour of the use of nitrogen alone, instead of air, for conducting the permeability test at elevated temperatures, as this is not representative of foundry conditions.

It is obvious, however, that from your comments, you have taken a considerable interest in the Paper, and consequently this is gratifying; whilst at the same time you have not produced any evidence to shake the conclusions reached, namely, that the reduction in permeability is principally due to the effect of gaseous expansion.

A second communication from MR. WALKER reads:—With regard to your remarks about Gay-Lussac's Law, I must disagree with you completely regarding the validity of this law at high temperatures. There is no doubt whatever that all the permanent gases obey this law to a far greater degree of accuracy than you could possibly determine in your experiments, to a much higher temperature than 1,000 deg. C. Constant-pressure gas thermometers have been constructed and are employed for the accurate measurement of high temperatures, and in this connection the coefficients of expansion of most of the permanent gases have been determined repeatedly with very close agreement in the results. For example, Jaquerod and Perrot determined the expansion of air from 0 deg. C. to 1,067 deg. C. (the melting point of gold) and found the value of the coefficient to be 0.0036663. This is almost identically the same figure as is obtained for the coefficient of expansion between 0 deg. C. and 100 deg. C., showing that the expansion of air between 0 deg. C. and 1,000 deg. C. is, for all practical purposes, at a uniform rate.

You refer in your letter to the effect of moisture in the air as being sufficient to upset the law. Actually, the coefficient of expansion of water vapour between 0 deg. C. and 247 deg. C. is given in the Smithsonian tables as 0.003799. This figure is somewhat greater than the coefficient of expansion of dry air, but it diminishes as the temperature rises, and above its critical temperature, which is 347 deg. C., it rapidly approaches the coefficient of expansion of the permanent gases.

I notice that you also refer to the presence of combustible matter in the moulding materials vitiating the results of volume calculations, but surely, if combustible or other matter is volatilised during the period of heating, or during the period of standing at a constant temperature (which latter time, incidentally, I feel is much too short to ensure uniformity of temperature throughout the specimen), it will escape, since the specimen is presumably in contact with the external atmosphere, from a pressure point of view, except when the test is actually being carried out?

It is true that any carbonaceous matter present in the material at high temperatures will be oxidised by the passage of heated air through the specimen, but this could be obviated by using nitrogen as the gas to be passed through instead of ordinary air. In any case, at the high temperatures you are using, the carbonaceous material will mostly consist of carbon itself, which, on oxidation, gives carbon dioxide of precisely the same volume as the oxygen which is used up during the process.

Returning to Figs. 3 and 4, assuming, for the sake of argument, that the smooth curve shown in Fig. 3 is correct as a record of the experimental result obtained, it is quite clear that Fig. 4, which is obtained from Fig. 3 merely by calculation, must also be a smooth line instead of a series of straight lines as shown. The fact that it has kinks in it is merely because you have taken only five points and joined them up by straight lines. Actually, there appears to be an arithmetical error in your calculated volume at 200 deg. C., which, by your own method of calculation (reading the value for the permeability from Fig. 3 as accurately as the size will permit), should be 3,220 c.c. instead of the figure shown in Fig. 4 of a little over 4,000 c.c. When this value is inserted and a number of other points are calculated, a smooth curve may be drawn through all the points, giving the result shown on the enclosed diagram. I think, on reckoning your own figures, you will agree with this point.

I quite agree with your remarks that there has so far been far too little work done on the properties of mould and core materials at elevated temperatures, and I am sure that this offers a profitable field for investigation.

To this the AUTHOR replied:—In regard to your letter of November 28, I am interested to note your remarks in regard to the expansion of air. As a matter of fact, we tried to calculate out, as you have done, the degree of

(*Concluded on page* 466.)

Recommended Practice for the Common Aluminium-Copper Alloys*

GENERAL RECOMMENDATIONS FOR ALUMINIUM ALLOYS

(*Concluded from page* 455.)

RECOMMENDED PRACTICE FOR THE COMMON ALUMINIUM-COPPER ALLOYS

Chemical Control Limits

The strength of the aluminium-copper sand castings increases rapidly with copper content up to about 4 per cent. and then more slowly up to about 12 per cent. Conversely, the elongation decreases continuously and the alloys become quite brittle at 10 per cent. copper or above. The most favourable combination of strength, elongation, toughness and casting properties seems to be reached at about 7 to 8 per cent. copper. The addition of controlled amounts of silicon and iron as in alloy B-12, effects a distinct improvement in the casting characteristics of these alloys. Iron tends to reduce the "hot shortness" of the alloy, thereby preventing to a considerable extent the occurrence of cracks. Silicon promotes fluidity of the alloy, making it easier to cast.

Another modification of the original 8 per cent. (B-11) alloy consists in the addition of small amounts of zinc for the purpose of improving machinability. At the same time, it is possible to increase the iron content over that of alloy B-11. This alloy containing zinc is alloy B-13. Alloy B-14, containing approximately 12 per cent. copper, and therefore rather brittle, has been found especially suited for castings requiring pressure tightness but which are lightly stressed and not subjected to impact shocks.

Chemical Control Limits.

Alloy.	Cu.	Fe.	Si.	Zn.	Other elements.
	Per cent.	Per cent.	Per cent.	Per cent.	
B-11	7.0–8.5	—	—	0.2 Max.	Total impurities less than 1.5 per cent.
B-12	7.0–8.5	0.8–1.2	1.0–1.5	0.2 Max.	Total impurities less than 0.3 per cent.
B-13	6.0–8.0	1.0–1.5	*	1.0–2.5	†
B-14	11.0–13.5	—	—	—	—

* The use of higher silicon content up to about 2.0 per cent. improves the casting qualities of this alloy without any adverse effect on the physical properties or machining characteristics of the casting. This is recognised in the following specifications:—S.A.E. 33–2.0 per cent. max. A.S.T.M. B26-33T Alloy C—1.0–3.0 per cent.

† A.S.T.M. B26-33T Alloy C—Mg 0.05 per cent. max., Mn 0.3 per cent. max., and other elements 1.0 per cent. max.

The majority of such castings are made in the 8 per cent. copper—2 per cent. zinc alloy (B-13 alloy). A much smaller number of the castings are made in the remaining three alloys. The original 8 per cent. copper (B-11) alloy is still used extensively for patterns, matchboard and corebox equipment. Alloy B-14 is well suited for pressure-tight castings such as motor-vehicle manifolds, pump housing and carburettors, which are lightly stressed and not subjected to impact shocks.

RECOMMENDED PRACTICE FOR THE HEAT-TREATED ALUMINIUM-COPPER ALLOYS

Chemical Control Limits

The improvement in the mechanical properties of this group of alloys by heat-treatment is possible largely because of the composition which must be closely controlled between the limits specified above. The best combination of strength and ductility is obtained by a solution heat-treatment followed by quenching. Tensile strength and hardness may then be further increased at a sacrifice of ductility by a precipitation treatment. The presence of magnesium results in an additional increase in tensile strength and hardness and reduction of ductility by the precipitation heat-treatment. Additions of magnesium up to 0.3 per cent. are beneficial when maximum strength and hardness are desired and ductility is not necessary.

Nickel is added to alloy B-23 to improve the strength at elevated temperatures and to minimise growth in the castings. Excess iron content in all of the alloys adversely affects machinability and tends to give a coarse and porous crystal structure. Silicon in small amounts increases soundness, but in larger amounts affects machinability and prevents in some cases complete and satisfactory heat-treatment.

Chemical Control Limits.

Alloy.	Cu.	Fe.	Si.	Zn.	Mn.	Mg.	Ni.	Others.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	
B-21 HT1	4.0–5.0	1.0 max.	1.2 max.	0.25 max.*	0.25max.**	0.02	—	Total elements other than Cu-Al 2.5% max.
B-21 HT2	,,	,,	,,	,,	,,	0.02	—	
B-21 HT3	,,	,,	,,	,,	,,	0·02†	—	
B-22 HT1	3.75–4.50	0.75 max.	0.50 max.	—	—	1.25–1.75	1.75–2.25	Total others 0.25% max.
B-22 HT2	,,	,,	,,	—	—	,,	,,	
B-23 HT1	9.25–10.75	0.90–1.5	—	—	—	0.15–0.35	—	Total others 0.75% max.
B-23 HT2	,,	,,	—	—	—	,,	—	

* U.S. Navy Dept. 46A1c class 4—zinc 0.03 per cent. max. ** U.S. Navy Dept. 46A1c class 4—Mn 0.03 per cent. max. † A.S.T.M. B26-33T Grade GG—Mg 0.3 per cent. max.

Development

The heat-treated aluminium-copper alloys were developed to meet the demands of industry for greater strength, ductility and impact resistance in castings than possible in the common aluminium-copper alloys. The first of the group to be developed was alloy B-21, containing 4 to 5 per cent. copper. This has found wide application as a general engineering alloy. Following this, alloys B-22 and B-23 were developed for more specific applications, particularly for pistons and cylinder heads in the aircraft and motor-vehicle fields.

The heat-treated aluminium-copper alloys are somewhat more difficult to cast than the common aluminium-copper alloys, because of certain differences in casting characteristics. The alloys in general possess good hardness and machine well. The corrosion resistance of the alloys, while not so good as that of the aluminium-silicon alloys, is superior to that of the common aluminium-copper alloys.

Alloy B-21 has the best combination of strength, ductility and resistance to impact. It is somewhat "hot short" and special attention must be given to foundry technique to overcome this tendency. The alloy is not particularly

1 U.S. Patents 1,572,487; 1,394,534; 1,732,557; 1,732,783 and 1,822,877.

ably hard and machine well. The corrosion resistance of this group of alloys, because of the high copper content, is not nearly so good as that of the aluminium-silicon alloys and aluminium-magnesium alloys or heat-treated alloys containing copper in lower percentages.

Physical Properties of Sand Castings

	Alloy B-11.	Alloy B-12.	Alloy B-13.	Alloy B-14.
Ultimate tensile strength, tons per sq. in., min. to avg.*	8.4–9.8	8.4–9.8	8.4–10.2	9.3–10.7
Yield strength, lbs. per sq. in. permanent set = 2.0 per cent. (avg.)	6.2	6.2	6.2	6.2
Modulus of elasticity, lbs. per sq. in. $\times 10^6$ (approx.)	10	10	10	10
Elongation, per cent. in 2 in. (min. to avg.)†	1.5–2.0	1.0–2.0	1.0–2.0	1.0–2.0
Brinell hardness, 10-mm. ball—500-kg. load (approx.)	65	60	70	75
Specific gravity (approx.)	2.83	2.84	2.86	2.89
Weight per cub. in. (lbs.) (approx.)	0.103	0.103	0.104	0.104
Patternmaker's shrinkage—in. per ft.	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32
Solidification range—(approx.) deg. C.	653–540	635–540	635–540	625–540

* Tension values determined from standard A.S.T.M. ½-in. dia. separately cast test specimens.

† Usually not included in commercial specifications because of the difficulty of measuring small elongations with accuracy.

Development

The aluminium casting industry in America originally developed around alloys in which copper was the principal hardening ingredient. The most widely used of these alloys, commonly known as No. 12 alloy, was made by the addition of approximately 8 per cent. copper to commercial aluminium ingot. For a long time, alloy B-11, commonly known as No. 12 alloy, was the standard casting alloy, but in recent years it has been replaced largely by other alloys having better foundry characteristics. While alloy B-11 is a fair casting alloy for general purposes, other alloys were developed to meet the more exacting requirements of the trade. Variations from the original chemical composition have created a group of alloys known as the common aluminium-copper alloys.

These alloys are easy to cast providing that the pattern is not too intricate. They are somewhat "hot short" and therefore susceptible to cracking under certain conditions. They are reasonably hard and machine well. The corrosion resistance of this group of alloys, because of the high copper content, is not nearly so good as that of the aluminium-silicon alloys and aluminium-magnesium alloys or heat-treated alloys containing copper in lower percentages.

Field of Use

The common aluminium-copper alloys are still used quite extensively for castings which do not require exceptionally high mechanical properties or resistance to impact. They are employed in the motor-vehicle industry for crankcases, oil pans, transmission housings, manifolds, carburettors, and miscellaneous fittings and parts for body, chassis and engine.

In addition, the alloys are used in casting various parts of washing machines, and as die-castings for vacuum cleaners, multigraphs, typewriters and adding machines. It has been estimated that 50 per cent. of the aluminium foundry output of castings is made in the common aluminium-copper alloys.

* Abstracted from the Report of the Non-Ferrous Division Committee on Recommended Practices of the American Foundrymen's Association.

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adapted to intricate thin-walled castings which must be leak-proof. Alloys B-22 and B-23, developed principally for pistons and cylinder heads, possess high tensile strength, hardness and resistance to wear at normal temperatures and good strength at elevated temperatures.

Physical Properties of Sand Castings

	Alloy B-21 HT1	Alloy B-21 HT2	Alloy B-21 HT3	Alloy B-22 HT1	Alloy B-22 HT2	Alloy B-23 HT1	Alloy B-23 HT2
Ultimate tensile strength, tons per sq. in. (min. to avg.)*	12.5–14.2	14.2–15.6	16.07–17.8	12.9–14.2	14.2–16.07	10.2–11.1	13.3–15.6
Yield strength, lb. per sq. in. (permanent set = 0.2 per cent.) (avg.)	7.1	9.2	12.05	10.7	13.3	9.3	13.3
Modulus of elasticity, lb. per sq. in. X 10^6 (approx.)	10	10	10	10	10	10	10
Elongation, per cent. in 2 in. (min. to avg.)	6.0–9.0	3.0–5.0	0.0–1.0	0.0	0.0	0.5–1.0	0.0
Brinell hardness, 10-mm. ball 500 kg. load (approx.)	65	80	95	95	100	75	110
Specific gravity (approx.)	2.77	2.77	2.77	2.79	2.79	2.93	2.93
Weight per cu. in.—lbs. (approx.)	0.10	0.10	0.10	0.101	0.101	0.106	0.106
Pattern maker's shrinkage, in. per ft.	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32
Solidification range—° C.	645–548.5	645–548.5	645–548.5	629–535	629–535	626.5–540	625.5–540

* Tension values determined from standard ½-in. dia. A.S.T.M. separately cast specimens.

Field of Use

Alloy B-21, with its various combinations of mechanical properties possible by heat-treatment, is widely used as a general engineering material. It is used for crankcases for lorries, motor coaches and aircraft engines. It is also used for miscellaneous fittings for marine, motor-vehicle, outboard-motor and aircraft applications. In addition to this, there are many applications of this alloy in the electrical, machine-tool, textile and other industries.

RECOMMENDED PRACTICE FOR THE COMMON ALUMINIUM-SILICON ALLOYS

Chemical Control Limits

The presence of the various impurities has an appreciable effect upon the mechanical properties and corrosion resistance of alloy B-31. The corrosion resistance is lowered by the presence of copper and zinc and to a lesser extent by iron. The percentage of elongation is lowered by the presence of iron and to a lesser extent by the other impurities.

Chemical Control Limits.

Alloy.	Cu.	Fe.	Si.	Zn.	Mn.	Mg.	Other elements.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
B-31*	0.10 max.†	0.80 max.	4.5– 6.0‡	0.03 max.	0.03 max.	0.03 max.	0.03 max. each.
B-32	0.15 max.§	0.80 max.	12.0–13.0	0.03 max.	0.25 max.¶	0.03 max.	—

* Conforms to U.S. Navy Dept. Specification 46A1c class 2. † A.S.T.M. No. 26-33T alloy J—0.40 per cent. copper max. ‡ A.S.T.M. No. 26-33T alloy J—0.20 per cent. zinc max. § A.S.T.M. No. 26-33T alloy K—0.30 per cent. copper max. ‖ A.S.T.M. No. 26-33T alloy K—0.20 per cent. zinc max. ¶ A.S.T.M. No. 26-33T alloy K—0.50 per cent. Mn max.

Excessive iron content tends toward coarse grain size in the modified (B-32) alloy, which results in inferior mechanical properties. Copper tends to reduce corrosion resistance and impact strength. Silicon above the specified maximum tends to make satisfactory modification difficult.

Development

The common aluminium-silicon alloys were developed to meet the need for improved casting characteristics and corrosion resistance. Alloy B-31, containing about 5 per cent. silicon, because of its fluidity, is especially suitable for thin-section intricate castings. The alloy is widely used for pressure-tight castings. The corrosion resistance of the alloy is appreciably better than that of the common aluminium-copper alloys, and for this reason finds use in ever-widening fields.

Alloy B-32, containing about 12.5 per cent. silicon, has somewhat similar casting characteristics to alloy B-31, but better mechanical properties. When cast in sand, these properties are only possible through a special "modification" process. This process, which is patented, consists of a controlled addition to the molten metal prior to pouring of certain modifying agents, such as sodium.

Physical Properties of Castings

	Alloy B-31	Alloy B-32
Ultimate tensile strength, tons per sq. in. (min. to avg.)*	7.5–8.9	10.7–12.5
Yield strength, tons per sq. in. (permanent set = 0.2 per cent.) (avg.)	4.4	4.8
Modulus of elasticity, lbs. per sq. in. X 10^6 (approx.)	10	10
Elongation, per cent. in 2 in. (min. to avg.)	3.0–8.0	5.0–7.0
Brinell hardness, 10-mm. ball—500-kg. load (approx.)	40	50
Specific gravity (approx.)	2.65	2.66
Weight per cu. in. (lbs.) (approx.)	0.096	0.095
Patternmaker's shrinkage—in. per ft.	1/10–5/32	1/10–5/32
Solidification range—deg. C.	645–576.5	610–576.5

* Tension values determined from standard ½-in. dia. A.S.T.M. separately cast test specimens.

Field of Use

Alloy B-31 is used quite extensively for architectural applications, such as spandrels, panels, mullions and ornamental grille work. It is used for some outboard motor and marine fittings, water jackets and manifolds. There are numerous industrial applications where pressure tightness and corrosion resistance are necessary and the mechanical properties are adequate. Alloy B-32 finds limited use in America because heat-treated alloy castings with somewhat better characteristics are available. It is, however, being used quite extensively in Europe for motor-vehicle, marine and machine-tool applications.

RECOMMENDED PRACTICE FOR THE ALUMINIUM-MAGNESIUM ALLOYS

The excellent physical and mechanical properties of the aluminium-magnesium alloys depend largely upon the purity of the metal. It is therefore essential that iron and silicon content be kept at a minimum to realise maximum mechanical properties and corrosion resistance. Several modifications of this alloy, however, employ 1 to 2 per cent. silicon, which is added to improve the casting characteristics. In spite of these additions, such an alloy has excellent corrosion resistance, although slightly inferior to alloy B-61.

Copper tends to lower corrosion resistance and, to a lesser extent, mechanical properties. Iron tends to lower the corrosion resistance and mechanical properties of alloy B-61. Another modification of alloy B-61 includes 0.5 per cent. manganese, which is added to improve corrosion resistance. There is some question whether such an addition effects any appreciable change in this factor, although it does tend to reduce the oxidation of the magnesium.

Physical Properties of Sand Castings

	Alloy B-61
Ultimate tensile strength, tons per sq. in. (min. to avg.)*	9.8–11.1
Yield strength, tons per sq. in. (permanent set = 0.2 per cent.) (avg.)	5.3
Modulus of elasticity, lbs. per sq. in. X 10^6 (approx.)	10
Elongation, per cent. in 2 in. (min. to avg.)	6.0–8.0
Brinell hardness—10-mm. ball, 500-kg. load (approx.)	50
Specific gravity (approx.)	2.65
Weight per cu. in.—lbs. (approx.)	0.095
Patternmaker's shrinkage, in. per ft.	1/10–5/32
Solidification range—deg. C.	640.5–525

* Tension values determined from standard ½-in. dia. A.S.T.M. separately cast test specimens.

Development

The past few years have witnessed the introduction of an aluminium-magnesium alloy containing 4 per cent. magnesium as the major alloying element. This is by no means a new alloy. However, it is only recently since high-purity aluminium has been available that the most desirable characteristics have been realised. Alloy B-61 (4 per cent. magnesium) is not susceptible to heat-treatment and is therefore used in the "as-cast" condition. The outstanding characteristic of this alloy is its exceptional resistance to corrosion, and for this reason it is used for applications in which even the aluminium-silicon alloys are unsatisfactory.

Alloy B-61 is somewhat more difficult to cast than many of the previously discussed alloys. Additional precautions in foundry technique must be taken to ensure freedom, particularly from shrinkage, dross and oxidation of magnesium. The alloy is not considered "hot short" and consequently castings can be made with little danger of cracking. The alloy machines quite well, although the hardness is not exceptionally high. This alloy is not considered to be especially pressure-tight. In this respect it is inferior to the aluminium-silicon alloys. Proper observance of certain phases of foundry technique, however, will tend to materially improve this condition. The alloy is capable of taking a very excellent polish and is especially adapted to anodic finishes.

Field of Use

Alloy B-61 is finding extensive application where maximum resistance to corrosion and discoloration is desirable or necessary. The alloy is used for cooking utensils, dairy and plumbing equipment, pipe fittings and valves, and cash

Chemical Control Limits

Alloy.	Cu.	Fe.	Si.	Mg.	Others.
	Per cent.	Per cent.	Per cent.	Per cent.	
B-61	0.10 max.*	0.40 max.	0.25 max.	3.25–4.25	Total imp. 0.60 per cent.

* U.S. Army Specification 57–72–4—0.05 per cent. max.

register and railway carriage fittings. Since the alloy takes a high polish and is well adapted to anodising, it is used for vending-machine parts and ornamental architectural castings.

RECOMMENDED PRACTICE FOR THE HEAT-TREATED ALUMINIUM-SILICON ALLOYS

Chemical Control Limits

The tensile and yield strengths and hardness of the aluminium-silicon alloys increase with copper and magnesium content. The addition of these elements much beyond the specified limits results in excessive brittleness. Iron is exceptionally harmful with respect to elongation, and should be maintained as low as possible.

Chemical Control Limits.

Alloy.	Cu.	Fe.	Si.	Mg.	Mn.	Ni.	Other elements.
B-41 HT1	1.0–1.5	0.5 max.	4.50–5.50	0.40–0.60	—	—	Total others 0.30 per cent. max.
B-41 HT2	,,	,,	,,	,,	—	—	
B-41 HT3	,,	,,	,,	,,	,,	,,	
B-42 HT1	0.20 max.	0.5 max.	6.50–7.50	0.20–0.40	—	—	Total others 0.20 per cent.
B-42 HT2	,,	,,	,,	,,	—	—	
B-43 HT1	1.2–1.75	0.6 max.	4.50–5.50	0.40–0.60	0.60–1.00	0.60–1.00	Total others 0.20 per cent.
B-43 HT2	,,	,,	,,	,,	,,	,,	

The lower copper and magnesium of alloy B-42, together with an increase in silicon over alloy B-41, reduces the tensile strength somewhat, but improves the ductility. Alloy B-42 possesses excellent corrosion resistance.

The addition of nickel and manganese, although reducing the ductility of alloy B-43 at room temperatures, materially improves the mechanical properties at elevated temperatures.

Physical Properties of Sand Castings.

	Alloy B-41 HT1	Alloy B-41 HT2	Alloy B-41 HT3	Alloy B-42 HT1	Alloy B-42 HT2	Alloy B-43 HT1	Alloy B-43 HT2
Ultimate tensile strength, tons per sq. in. (min. to avg.)*	12.05–13.3	14.2–16.07	11.1–12.05	11.6.12.9	13.3–14.7	11.1–12.5	10.2–11.6
Yield strength, tons per sq. in. (permanent set = 0.2 per cent.) (avg.)	8.9	12.05	10.2	7.1	9.2	10.7	9.3
Modulus of elasticity, lb. per sq. in. X 10^6 (approx.) ..	10	10	10	10	10	10	10
Elongation, per cent. in 2 in. (min. to avg.)	4.0–5.0	2.0–3.0	1.0–2.0	5.0–7.0	3.0–5.0	1.0–2.0	1.0–2.0
Brinell hardness (10-mm. ball, 500-kg. load) (approx.) ..	60	80	60	55	70	60	55
Specific gravity (approx.) ..	2.67	2.67	2.67	2.63	2.63	2.74	2.74
Weight per cu. in. (lbs.) (approx.)	0.096	0.096	0.096	0.095	0.095	0.099	0.099
Pattern maker's shrinkage, in. per ft.	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32	1/10–5/32
Solidification range—deg. C.	626.5–525	626.5–525	525–626.5	610–626.5	610–626.5	—	—

* Tension values determined from standard ½-in. diameter A.S.T.M. separately cast test specimens.

Development

The heat-treatable aluminium-silicon alloys were developed to combine the excellent casting characteristics of this type of alloy with the improved mechanical properties resulting from heat-treatment, the benefits of which are so evident through the use of heat-treated aluminium-copper alloys. The silicon alloys are much easier to cast than the latter alloys and at the same time have comparable mechanical properties. The aluminium-silicon alloys, because of their fluidity, are especially adapted for intricate castings with thin sections. In addition to this they are not "hot short" and are generally quite leak-proof. This group of alloys is more resistant to corrosion than the aluminium-copper alloys. They also possess good machinability and are amongst the best for electroplating and anodising.

Field of Use

The heat-treatable aluminium-silicon alloys are finding application in ever-widening fields, displacing aluminium-copper alloys largely because of their superior casting characteristics and resistance to corrosion. In many cases their superior mechanical properties make them preferable to the common aluminium-silicon alloys.

These alloys are widely used in Diesel engines for such parts as crankcases, oil pans, manifolds, cylinder heads and supercharger equipment. They are used for cylinder heads, manifolds and housings in motor-vehicle engines. The alloys are used in some aircraft engines for cylinder heads, crankcases, jackets, housings and covers. Alloy B-41 is particularly adapted for liquid-cooled cylinder heads requiring, in addition to pressure tightness, good mechanical properties at temperatures up to 205 deg. C. Alloy B-43 was developed principally for air-cooled aircraft cylinder heads where strength at temperatures from 205 to 315 deg. C. is an important requisite.

The heat-treated aluminium-silicon alloys are also employed for air-compressor and air-brake parts and pneumatic tools. In addition to this, they are used for fans, impellers, tank-car fittings, housings and covers for electrical, textile and foodstuff equipment, as well as many other miscellaneous industrial applications.

Veining in Ferrite

In investigations on the effect of nitrogen and oxygen on the veining of ferrite carried out on a series of pure iron specimens with different percentages of oxygen and nitrogen, W. EILENDER and H. CORNELIUS found that no connection existed between the degree of veining and the gas percentages. The experiments made indicate some connection between α-veining and the stresses produced by γ-α-transformation. Impurities apparently play only a very subsidiary part in veining. A brief report of this work with micrograph reproductions is published in the "Archiv für das Eisenhüttenwesen."

The Health Insurance and Pensions Act, 1935

By F. J. TEBBUTT.

The Health Insurance and Pensions Act, 1935—a measure of several sections, some of which, however, do not apply until January 1—is at present important to both voluntary and employed contributors. The Arrears Rules apply not only currently, but really retrospectively also, as the new procedure was used for the computation of contribution totals in the contribution year ended July 7, 1935, upon which totals will be decided the rates of benefit available for benefit year commencing January 6, 1936. A contribution total may include contributions paid during the year, credits in full for any weeks of sickness, and payments made in the period of grace, which ended on November 30, by way of liquidation of arrears; these rules apply to both voluntary and employed contributors. In addition, the Act now provides that an employed contributor can secure credits in full for any properly-proved weeks of unemployment. The common practice for securing such credits is by getting an Health Insurance card franked at an Employment Exchange, and this franking can be obtained whether unemployment benefit is claimed or not. There is, however, also an alternative method of providing evidence of genuine unemployment. This is by way of a declaration form, obtainable from the relevant approved society, on which the person concerned gives days upon which he declares he was available for, but unable to obtain, employment, and further states that on those days also he had done no paid work or worked on his own account. Arrears payments are made by affixing to an arrears card stamps to such a number as the person concerned considers sufficient for his purpose, the important factor being that the higher the contribution total finally recorded, the higher the rates of benefit payable in 1936. A voluntary contributor, if he has retained his ordinary card, can use that card instead of an arrear card if he so desires. The stamps cost 1s. 6d. for men and 1s. 1d. for women, being the combined contributions of employer and employee, and are the ordinary Health Insurance and Pensions stamps. That is, ordinary contributors, both "elderly voluntary" and "employed" contributors, may liquidate arrears at a reduced rate of 9d. for men and 8½d. for women, in order to bring up a total of 26 to a higher number. For completing a total of 26, payments must be made at full rates. An "elderly" contributor, either in the voluntary or employed class, is a man at 60, or a woman at 55, years who can prove having been insured for ten years since their last entry into insurance. Arrears contributions at full rates count for all Health Insurance and all Pensions purposes. Payments of arrears at reduced rates do not apply for any Pensions Acts purposes, or for any qualifying purposes under Health Insurance. For example, they do not count for the completion of the first 26 or 104 actually paid contributions, which qualify for eligibility for consideration for benefits when first entering insurance. If the contribution total finally recorded is 35 or less, no sickness or disablement benefits will be payable in 1936; if the total is only 25 or less, no maternity benefit either is payable.

A voluntary contributor should, however, particularly note that he must record 45 a year, and an elderly voluntary contributor 26 a year—sickness weeks counting the same as actual payments—or else the right to continue in voluntary insurance ceases. If 45 or 26 is the final total, rates of benefit come under the arrears scales as above, and full rates would not, of course, be available. To secure full rates of

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sickness and disablement, an insured person of any class must register 50 contributions, credits or actual payments. The contribution year 1934-35 contained 53 weeks, and three contributions were allowed to all persons. If the final total be 36 and up to 49, there would be deductions from the full rates, ranging from 9s. to 1s. for sickness and 4s. 6d. to 6d. for disablement benefit.

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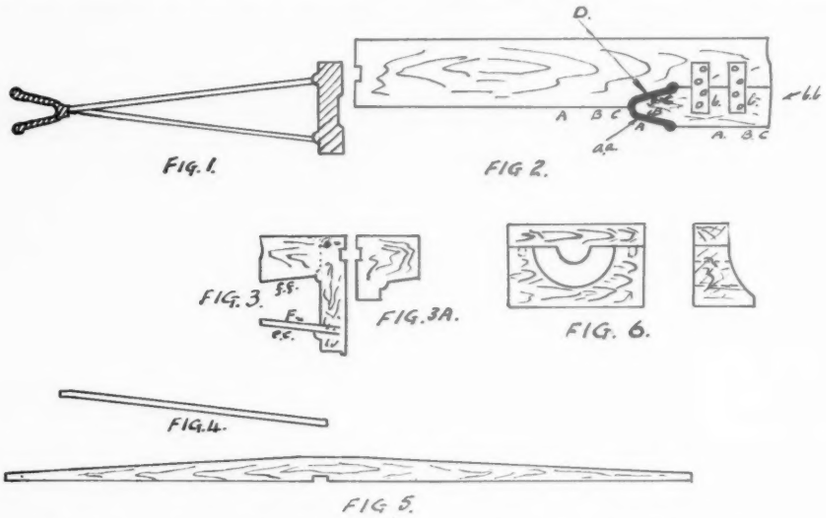
Leaves from a Foundryman's Notebook

V.—MOULDING SHEAVES

By RECORDER

One of the most interesting of the castings which the foundryman is called upon to produce in a jobbing shop is a sheave pulley, especially if it be only a one-off job and a pattern the replica of the casting is supplied. This is moulded in a two-part box with a "floating joint," and is a work of art. When the size of the sheave increases and a complete casting is considered weak, sheaves are made with a cast-iron boss and rim connected by wrought-iron spokes. The job then becomes even more interesting than moulding the smaller sizes from patterns, and a brief description of the methods adopted is appended.

Fig. 1 shows a half-sectional view of such a sheave or pulley as used on pithead gears in mines for haulage purposes. The mould for this example is struck up in loam and the general remarks given in the second article of this series relative to loam moulding can also be applied to this case. The tackle the patternshop is required to supply consists of a loam sweeping board, as Fig. 2, for the rim. This is made up of the various detachable pieces indicated, which will be explained later. Two sweeping boards for the boss, as Figs. 3 and 3A, complete the sweeps, but 24 half-round prints for the arms are required, as is also a corebox in which 24 cores are made (Fig. 6).



These cores are used as pattern bosses and are tarred preparatory to using. A centre corebox completes the pattern equipment but 12 wrought-iron arms are required and these are obtained from the smiths' shop, made to a template supplied by the patternmaker.

When the patternwork arrives at the moulding shop, a vertical spindle is placed in position and a ring of cast iron is placed over this and rests on trestles. The ring is made of sufficient size to allow of the building of the rim mould on it. The sweeping board, Fig. 2, is now bolted to the spindle and loam is built up to line AAA in Fig. 2. A notched straightedge, Fig. 5, is now used in conjunction with a pair of compasses to divide up the rim into twelve equal spaces; each dividing line becomes the centre of an arm.

Twelve of the boss pattern cores having been made in the meanwhile, they are now placed in position on the centre lines; of course, a portion of the loam has to be dug out to accomplish this. The board, Fig. 2, is again rotated to make good any irregularities in the surface and portion *aa* is then removed. A dusting of parting sand being applied to this surface after it has been allowed to stiffen, a thickness of red sand is swept on to line BBB.

Portion *bb* is then removed and the "gullet" part of the mould proceeded with. This consists in placing a grid to carry this part of the mould in place, and sweeping loam up to line CCC. This grid is in two pieces to carry this mould in halves, the reason being to avoid distortion on the expansion of the grid on drying.

Provision is made on each grid for clamping together in position, these clamps being released on casting. The gullet part being finished, it is allowed to stiffen and a dusting of parting sand is applied to its face when portion D of the sweep board is removed and the top thickened with red sand as the bottom. Cores and prints being placed over those in the bottom, loam is placed over this and a building ring as used to begin with is put on the whole and guide marks cut on the sides with a trowel. This is then stoved for drying. Meanwhile a plate of dimensions somewhat bigger than the required centre boss is obtained and board, Fig. 3, bolted to the spindle.

Building being commenced, it is swept up to *ee*, which is the slope of the arms. Six half prints being spaced out and placed in position, finger F is removed. Other half prints being located on the first six, the boss is swept up to *ff* and six more half prints are placed in correct relation with those under them. The new position can be obtained by setting the edge of the sweeping board on the centre of the print below and marking it with the trowel on the top. Two being thus marked, the space can be halved and six spaced off from the new line, and the prints bedded in.

The board, after making a final sweep is removed, as are also the top prints, and the boss is stoved. The portion 3A is treated similarly as the bottom of Fig. 3, six half prints being bedded in. The gullet mould is now taken out of the stove and parted, the sand being removed and also the pattern bosses, and the mould is blacked and again dried—this time separately. The boss is also blacked and again dried, and the job of assembly is commenced.

The bottom of the boss and rim are placed in correct relation to one another in the position they are to occupy when they are cast, six of the arms being placed in, the middle portion of the boss is put on and then the other six arms are inserted. The top or cope of the boss is now put on and finished off. The two halves of the gullet mould are now put in position, guided by the trowel marks, as is also the cope.

Before the arms are placed in the mould, they should be coated with a mixture of white lead and turpentine, and warmed. The rim and boss should not be cast together as a great strain would be introduced into the wrought-iron arms on contracting; thus the rim should be cast one day and the boss another. The rim is run between two arms and each boss has a little pop-up, to ensure complete filling of the boss and proper uniting of the arms with the ring. The boss is run at the centre, and, if considered necessary, rod-fed.

When sheaves are required of fairly large dimensions, that is, of 10 to 12 ft. dia., the above method may not prove ideal, as the gullet mould may sag, and on fitting up and running the job may be found to be running out of truth. For these large sizes it is usual preferably to make the gullet of a series of cores which are built around the bottom in the foundry floor, the whole being covered by a loam plate. On the larger size sheaves, it is often advisable to split the casting through the centre boss longitudinally in order to take up any warp arising during cooling.

Federated Foundries, Limited

Federated Foundries, Limited, are to acquire the issued share capital of Messrs. Thomas Allan & Sons, Thornaby-on-Tees; Camelon Iron Company, Falkirk; Cameron & Roberton, Kirkintilloch; Grangemouth Iron Company, Falkirk; Jackson, Elphick & Company, Birkenshaw, Larkhall; David King & Sons, Possilpark, Glasgow; Walter Macfarlane & Company, Possilpark; Saunders & Connor Barrhead; Southern Foundries (1926), Waddon, Surrey; Warrington Light Castings Company, Warrington, and Watson, Gow & Company, Falkirk. Each of the companies will maintain its separate existence and no changes in the present managements are contemplated. The authorised capital of Federated Foundries, Limited, is £1,300,000 divided into 300,000 5 per cent. cumulative preference shares and 1,000,000 ordinary shares all of £1 each. Mr. William Rennie, of Messrs. David King & Sons, Limited, has been appointed chairman of the holding company, and the other members of the board of directors are:—Mr. G. L. Anderson (Camelon Iron Company); Mr. John Cameron (Cameron & Roberton); Mr. J. N. Deas (Thomas Allan & Sons); Mr. Samuel Ewart (Saunders & Connor (Barrhead), Limited); Mr. J. Fairclough (Warrington Light Castings Company); Mr. John M. Jackson (Jackson, Elphick & Company); Colonel Walter Macfarlane (Walter Macfarlane & Company); Mr. J. H. Calder Macleod (Grangemouth Iron Company and Watson, Gow & Company), and Mr. Alan Shirlaw (Southern Foundries (1925), Limited).

Striations in Tin Coatings on Copper

The International Tin Research and Development Council has just issued Technical Publication Series A, No. 23, a reprint of the Paper on the above subject which the authors, Dr. Bruce Chalmers and Dr. W. D. Jones, contributed to the "Transactions" of the Faraday Society last September. Under certain conditions of tinning, striations are plainly visible to the naked eye across strips of copper which have been allowed to cool from one end so that crystallisation occurs uniformly in one direction. In ordinary practice the irregular cooling of the coating prevents the striations occurring in a regular and obvious pattern, but they then form concentrically about the nuclei of crystallisation. Under a low-power microscope the pattern is seen to consist of alternate smooth and mottled surfaces across the single crystals of tin. It is shown that the effect is due to the crystal facets being inclined to the surface in a periodically varying manner within the single crystals of tin. Examination of a number of specimens by optical and metallographic methods shows the phenomenon to be related to the crystallisation of the tin and copper-tin eutectic. Copies of the above Paper may be obtained free of charge from the International Tin Research and Development Council, Manfield House, 378, Strand, London, W.C.2.

This Week's News in Brief

Trade Talk

THE DIRECTORS and employees of the Hammond Lane Foundry Company, Limited, Dublin, have this year distributed a sum of £175 15s. amongst the city hospitals.

ACCORDING TO Mr Hugh P. Vowles, the Old Rectory, Harescombe, Glos, in a letter to "The Times," the Stanton Ironworks in 1877 was the first foundry to be equipped with electric light.

DEVELOPMENTS WHICH are to be undertaken at the Renfrew works of Messrs. Babcock & Wilcox, Limited, include the rebuilding of the steel foundry, the installation of three new electric furnaces, and the extension of the welding shop.

MESSRS. COCHRANES (MIDDLESBROUGH), FOUNDRY, LIMITED, manufacturers of cast iron and centrifugally-made iron pipes, have opened an office in Birmingham at Lombard House, Great Charles Street, Birmingham, 3, with Mr. J. W. Elliot in charge.

THE ANNUAL DINNER and dance organised by the staff of Messrs. Hopkinsons, Limited, was held on Friday, December 13, at the Britannia Works, Huddersfield. During the evening the staff had the opportunity of seeing a film illustrating a trip round their own works.

FOLLOWING NEGOTIATIONS between the Joint Committee of Light Metal Trades Unions and the National Light Castings Ironfounders' Federation workers in the light metal trades have had restored wages cuts made in 1928. Further cuts imposed in 1931 were restored last year.

MR. G. E. WOLSTENHOLME, of Sheffield, gave the chairman's annual address to the Yorkshire branch of the Institution of Mechanical Engineers, at the Hotel Metropole, Leeds, on December 12. Mr. Wolstenholme's address was on "The Choice of Steels for Particular Purposes."

MESSRS. THOS. DUNLOP & SONS, Glasgow, have placed an order with William Doxford & Sons, Limited, Sunderland, for a 9,200-ton motorship of shelter-deck type, fitted with Doxford opposed-piston engines. This is the third motorship of this size ordered by Messrs. Dunlop in the last few weeks; the two others are being built by Barclay, Curle & Company, Limited, Glasgow.

IN THEIR HALF-YEARLY REPORT, the directors of John Williams & Sons (Cardiff), Limited, Cardiff, thank their "Safety First" Committee for the help given in recommending cases for dental assistance. Health Insurance Societies usually only pay half the cost of dentures. On the recommendation of the "Safety First" Committee, the company gives a free gift to employees who are unable to pay for the remaining half cost. Since this scheme started, over twenty cases have been assisted, with great benefit to the general health of those employed.

THE STAFF DINNER of Foundry Equipment, Limited, Linslade Works, Leighton Buzzard, was held at the Swan Hotel, Leighton Buzzard, last week. The toast of "Foundry Equipment, Limited," was proposed by Mr. F. O. Blackwell, works manager of the Davis Gas Stove Company, Luton. Replying, Mr. J. W. Corrie, chairman of directors, said that they had got a fair number of orders now. Negotiations were going on for a lot more, and with anything like luck they should soon have full works. Mr. A. S. Beech, managing director, welcomed the visitors, and Mr. H. Gentles replied.

MESSRS. WILLIAM GRAY & COMPANY, LIMITED, of West Hartlepool, who have only built two vessels in the past twelve months, have now six ships on order. The latest contract booked is for a 4,250-ton cargo steamer, to be built for Messrs. Frederick Jones & Company, of Cardiff. The Furness Shipbuilding Company, Limited, of Haverton Hill-on-Tees, have ten vessels on order, and Messrs. Smith's Dock Company, Limited, have orders for twelve trawlers, so that Tees shipbuilders will begin 1936 with 30 vessels to build.

SIR FRANK SMITH, secretary of the Department of Scientific and Industrial Research, gave his presidential address, on the subject of "Coal, Power and Smoke," to the Junior Institution of Engineers in London on Friday, December 13. Speaking of the decreased consumption of coal through its better utilisation, Sir Frank Smith said that it must be welcomed, sad as was the immediate effect on the coal industry. If it were checked, the industrial productivity of the nation would also be checked. Better utilisation led in the end to an increase of demand.

ON NEW YEAR'S EVE a short radio broadcast will be given from Messrs. J. Taylor & Company's bell foundry at Loughborough. The programme will consist of a brief talk by Mr. J. Smith, who is a foreman at the works, and he will relate his experiences with different bells he has helped to cast. As Mr. Smith is over 70 years of age, his reminiscences of this famous Loughborough industry should prove full of interest. Mr. E. Denison Taylor, the bell founder, will also speak. To conclude the relay, a number of bells at the foundry will be rung, including the big tenor bell of Buckfast Abbey peal, which has been re-cast.

THE ANNUAL STAFF DINNER of Messrs. Thomas L. Hale (Tipton), Limited, was attended by about 500 at Wednesbury Town Hall last week. The principal guest, the Earl of Harrowby (Lord Lieutenant of Staffordshire), proposed the toast of "The Firm," and mentioned the fact that a few years ago the employees numbered 500, but to-day they were about 1,000, and they still had visions of doubling that number in a few years' time. If they put all the moulds they made in a week on edgeways, they would reach from Wednesbury to Dudley—a distance of four miles. Mr. W. E. Hale, the managing director, replied. A joint presentation of a silver tea service from the workpeople to the directors, Mr. T. L. and Mr. W. E. Hale, was made by Miss C. Carline, the oldest female member of the staff, whilst Mr. J. Westley, a foundry foreman, on behalf of the chiefs of departments, gave the brothers a handsome grandfather clock.

Company Reports

Greenwood & Batley, Limited.—Interim dividend on the preference shares for the year to March 31, 1936, of 3½ per cent.

Bull's Metal & Melloid Company, Limited.—Brought in, £1,374; dividend of 2½ per cent.; depreciation, £2,261; carried forward, £1,969.

Platt Bros. & Company (Holdings), Limited.—A full year's dividend has been declared on the 4½ per cent. preference shares, thus bringing payments up to date.

Petters, Limited.—The improved position following the sale of one-half of the shares of Westland Aircraft, Limited, in July last enables the directors to recommend the dividend on the preference shares in arrear for the two years ended March 31, 1935, the half-year's interim on the preference shares for the current year, and a distribution to the ordinary shareholders in the form of a cash bonus of 2s. per share, free of tax.

Broom & Wade, Limited.—Accounts to September 30 show balance of £25,336, after depreciation but before income-tax and directors' additional remuneration. As company was only incorporated on February 15, 1935, profit earned between October 1, 1934, and that date is not available and is transferred to a capital reserve. Proportion of profit to be so dealt with amounts to £6,222. Tax provision is £4,000; to bonus to employees, £1,250; to additional remuneration of directors, £1,709; dividend on 6 per cent. cumulative preference shares for period ended September 30, £3,790; dividend on ordinary shares of 10 per cent., £4,732; carried forward, £3,632.

Cannon Iron Foundries, Limited.—Net profit, after charging all expenses, depreciation of buildings and plant and machinery, etc., £66,412, of which £30,893, representing the profits of the period prior to March 20, 1935 (being the date of the agreement for sale and purchase), is not available for purposes of dividend. The amount of £30,893, less £7,012, the dividend on vendor company's share capital as provided in the agreement, has been carried to capital reserve account. The profit and loss appropriation account shows that, after charging income-tax and dealing with the dividend on the preference shares up to September 30, 1935, there remains a balance of taxed profits available for distribution of £23,396. The directors recommend payment of a dividend on the ordinary shares of 7½ per cent., less tax, for the period March 20 to September 30, 1935, absorbing £14,531 and carrying forward £8,865.

Personal

MR. H. HARRIS, who has recently relinquished his post as senior lecturer in metallurgy at the University of Birmingham, received a presentation at the annual dinner of the University Metallurgical Society held last week.

MR. WILLIAM RENNIE, who has been appointed chairman of Federated Foundries, Limited, the new holding company that has been formed by the amalgamation of certain companies engaged in the light-castings industry (details of which are given elsewhere in this issue), is a nephew of the late Bailie John King, who was chairman of the National Light Castings Association from its inception. Mr. Rennie joined Messrs. David King & Sons, Limited, of Keppoch Iron Works, Glasgow, in 1899, and after experience in the various departments of the works and offices, represented the company in the West of England for some time.

MR. WILLIAM RENNIE.

Returning to Glasgow, Mr. Rennie became assistant to the late Mr. Donald M. King, then managing director of the company. He later became a director and subsequently took over complete control of the manufacturing activities of the firm. He became vice-chairman, and on the death of the late Bailie John King he was appointed chairman, assuming full control. Mr. Rennie was responsible for the starting of a branch foundry at Skipton, Yorkshire, and during his chairmanship this works has doubled in size and output. During the past twelve months he has been actively identified with the negotiations in connection with the present merger.

Obituary

MR. JABEZ PETHERICK, who was formerly a partner in an ironfoundry at Whitchurch, near Tavistock, where he also conducted an ironmongery business, has died, at the age of 71.

MR. DANIEL CORNTHWAITE, who for nearly 40 years was manager of the file department at the works of Messrs. Cammell Laird & Company, Limited, retiring about 1920, died in Sheffield recently.

Forthcoming Event

The Institute of Vitreous Enamellers

JANUARY 2.

Manchester:—"Colouring Oxides and how they are affected by Variations of Enamel Composition." Paper by W. G. Ball, of the Blythe Colour Works, Limited, at the Y.M.C.A., Peter Street, Manchester, at 7.30 p.m.

Raw Material Markets

Buying activity in the iron and steel trades has been at a low ebb this week, but consumption continues to be on a good scale, and the holiday period at many producing works was made as short as possible. Pig-iron is being taken up against existing contracts, but new business is scarce. The steel trade has received a further impetus from new shipbuilding contracts.

Pig-Iron

MIDDLESBROUGH. — Inquiries for pig-iron for delivery over various periods of next year are in circulation in this area, but makers are not anxious to book a long way ahead. The disposal of the output is assured, and no difficulty would be encountered in selling an increased production. Coke is not plentiful, and although two more blast furnaces are to be put into operation next month, further expansion in production is likely to be delayed. Fixed minimum delivered prices are unchanged, No. 3 Cleveland G.M.B. being quoted at 70s. in the Middlesbrough and Falkirk areas, 72s. on the North-East Coast and 73s. in Glasgow. No. 4 foundry and No. 4 forge qualities remain at 1s. per ton less than the foregoing figures, while No. 1 foundry grade is 2s. 6d. per ton more than No. 3.

East Coast hematite continues to have a very strong demand. Production has been temporarily reduced, and as a result makers are having difficulty in satisfying consumers' requirements. There has been an increase in the number of export inquiries, but these have to give place to the heavy demand from home consumers. Quotations are unchanged, No. 1 quality being quoted at 71s. per ton in the Middlesbrough district, 72s. on Tyneside, 73s. 6d. on the North-East Coast, 74s. in Scotland, 78s. 6d. in Sheffield and 84s. 6d. in the Midlands.

LANCASHIRE.—The Christmas holidays were, in most sections of the foundry trades, confined to two days. At the moment the light-castings industry is experiencing comparatively good activity, while the machine-tool makers, the heavy electrical engineering industry, the jobbing foundries and general engineers all report satisfactory conditions. Buying on forward account remains poor, but the position as a whole is very firm, with offers of Staffordshire, Derbyshire and Lancashire brands of No. 3 foundry iron for delivery in the Lancashire zone all on the basis of 78s. per ton, Northamptonshire at 76s. 6d. and Scottish No. 3 at from 83s. to 84s. The hematite market is firm, but prices are unaltered.

MIDLANDS.—The demand for pig-iron in this area continues unabated. The jobbing and general engineers remain well in the market and are taking up satisfactory tonnages. Quotations are unchanged, the controlled prices delivered Birmingham and Black Country stations for common irons being 72s. 6d. per ton for Northants No. 3 and 75s. for Derbyshire, Lincolnshire and North Staffordshire No. 3. These figures are subject to small rebates to large consumers only. Prices for special brands of iron are unchanged and the heavy foundries are taking supplies of specially refined pig at from £5 15s. to £7 12s. 6d., low-phosphorus from 89s. to 92s. 6d., Scottish at 90s. per ton and medium-phosphorus at 77s. 6d. to 80s. 6d. per ton delivered the Midland area. At a meeting of hematite manufacturers held recently the question of prices was discussed, but no alterations were announced. Prices delivered this area continue to be £4 4s. 6d. for West Coast mixed numbers, £4 3s. 6d. for East Coast No. 3 and £4 3s. for Welsh mixed numbers, delivered stations, with 1s. 6d. extra if delivered into works.

SCOTLAND.—Conditions in this area continue to be very satisfactory. Hematite and basic are receiving most inquiry. The demand for foundry qualities is not so insistent. Quotations are unchanged and the official minimum of 74s. f.o.t. furnaces for No. 3 foundry is still quoted, with 2s. 6d. extra for No. 1. Satisfactory conditions exist in the light-castings trade, with prospects of continuous employment. Founders are well contracted for supplies of pig-iron and prices are unchanged, with No. 3 Cleveland at 70s. f.o.t. Falkirk and 73s. f.o.t. Glasgow. Other English foundry irons are on offer at 1s. 3d. per ton less than the foregoing figures.

Coke

Prices of foundry coke are rather higher, and, although many of the consumers are well covered over several months at the old quotations, there is quite a flow of inquiries for supplies at the new figures. For delivery in Birmingham and district best Durham coke is from 41s. 6d. to 43s. per ton, and Welsh from 36s. to 47s. 6d. per ton, delivered South Staffordshire stations.

Steel

Reports from most districts show that the steelworks are well employed. The demand for joists and plates remains satisfactory and prompt delivery is not easily obtainable. The re-rollers are busy in their light mills and they have large orders awaiting delivery. The rail and plate mills continue to be well employed. In most cases the holiday has been of the shortest possible duration.

Scrap

The North-East Coast steelmakers, who hitherto have declined to go above 52s. 6d. per ton for heavy melting steel, are now offering 55s., but even so, supplies are not too plentiful. Machinery metal is scarce and keenly sought and up to 60s. has been paid. The minimum price for foundry cast-iron scrap is now 57s. 6d., while 46s. 6d. to 47s. 6d. is offered for clean light cast iron. All qualities of iron and steel scrap are in demand in the Midlands, but business is mainly for prompt delivery. Prices are firm. Cast-iron scrap is in good demand and good heavy machinery metal in handy sizes is being quoted at 57s. 6d. Short heavy steel scrap as used in the foundries is at 60s. delivered works. Quotations on the Scottish scrap market are very firm and a good demand exists for all qualities. Heavy mild-steel scrap is being quoted round about 52s. 6d. per ton for good qualities, and 5s. less for heavy furnace sizes. Heavy machinery cast-iron scrap is offered at 62s. 6d. to 63s. 6d., with ordinary cast iron, suitable for foundries, at 56s. 6d. to 57s. 6d. Piling wrought-iron scrap is on offer in the neighbourhood of 65s., while special quality is quoted at about 67s. 6d. per ton, delivered f.o.t. consumers' works.

Metals

Copper.—Rather better prices have been seen in this market during the past few days, in spite of the fact that the silver market turmoil has continued to influence all the non-ferrous metals unfavourably. However, it is gratifying to note that the industrial position of copper remains satisfactory and it is anticipated that a further decrease in world stocks will be seen in the early part of next year. Producers are expected to refrain from increasing output and thus keep stocks at a reasonable level, and also give the price situation a chance to improve. Business in the United States has slackened recently, but a revival should occur after the annual stocktaking period has passed.

Daily market prices :—

Cash.—Wednesday, £34 13s. 9d. to £34 15s.; Thursday, £34 6s. 3d. to £34 7s. 6d.; Friday, £34 11s. 3d. to £34 12s. 6d.; Monday, £34 16s. 3d. to £34 18s. 9d.; Tuesday, £35 1s. 3d. to £35 2s. 6d.

Three Months.—Wednesday, £35 2s. 6d. to £35 3s. 9d.; Thursday, £34 15s. to £34 16s. 3d.; Friday, £35 to £35 1s. 3d.; Monday, £35 5s. to £35 6s. 3d.; Tuesday, £35 8s. 9d. to £35 10s.

Tin.—A less encouraging tone has been apparent in this market and prices have receded further. The unsettled conditions prevalent in most other commodities seem to have affected the tin market also. It is anticipated that the stock position, which has been so stringent for several months past, will show some signs of improvement towards the end of January. However, the full benefit of the recently increased quotas will obviously not be felt for some considerable time. In the United States tinplate mills are enjoying increased activity and their output is now about 80 per cent. of normal, although stocks at the mills remain high. Prospects for this industry are good, as also are prospects in the motor-car trade.

Metal Exchange quotations were as follow :—

Cash.—Wednesday, £220 15s. to £221; Thursday, £219 15s. to £220 5s.; Friday, £218 10s. to £218 15s.; Monday, £216 15s. to £217 5s.; Tuesday, £216 5s. to £216 10s.

Three Months.—Wednesday, £210 12s. 6d. to £210 17s. 6d.; Thursday, £209 15s. to £210 5s.; Friday, £209 to £209 5s.; Monday, £208 10s. to £208 15s.; Tuesday, £207 15s. to £208.

Spelter.—This market has shown unsettled conditions during the past week, due, mainly, to the silver position and developments in the international situation. Consumption of zinc in the United States has been on a good scale, but trade buying has, on the whole, been only moderate. Prices have been maintained.

Official quotations were as follow :—

Ordinary.—Wednesday, £14 18s. 9d.; Thursday, £14 15s.; Friday, £14 17s. 6d.; Monday, £14 13s. 9d.; Tuesday, £14 15s.

Lead.—There has been a decline in this market during the past few days, but this may be only of a temporary nature. Buying on trade account has been only moderate and the Christmas vacation and the stocktaking interruptions have reduced it still further.

Day-to-day quotations :—

Soft Foreign (Prompt).—Wednesday, £16 15s.; Thursday, £16 11s. 3d.; Friday, £16 11s. 3d.; Monday, £16 2s. 6d.; Tuesday, £16 2s. 6d.

Book Review

General Foundry Practice. By ANDREW MCWILLIAM, C.B.E., A.R.S.C., D.Met., and Percy Longmuir, D.Met., M.B.E. Published by Charles Griffin & Company, Limited, 42, Drury Lane, London, W.C.2. Price 21s. net.

The first edition of this book was published in 1907, and since then it has been the standard text book for students of foundry practice. The developments which have taken place during the past 25 years or so have completely changed certain aspects of foundry practice, and it might be expected that a text book of this type would require complete revision. However, the fundamental principles of foundry practice are still the same, and it is in this respect that the new edition will still hold its place in foundry literature. When it is considered that the first big change in dry sand moulding technique, which has taken place since the first edition was published, is as yet only in the experimental stage in this country, *i.e.*, the cement-sand process of moulding, it will be realised that changes in actual foundry practice are not as numerous as might at first be supposed. On the other hand, there are many matters to which the student might have been given a more definite lead with suitable references, particularly as regards the mechanical and metallurgical aspects of foundry practice. Specialisation has taken place to a large extent in modern foundries, and a general text book loses much of its value unless it covers, if only in outline, the whole field of its subject. One must confess to a feeling of disappointment at finding no reference, for instance, to moulding sand tests or to round test bars for cast iron, both of which are regular practice in a large number of foundries. Many foundries would welcome more detailed treatment of cast-iron mixtures, particularly as regards total carbon and phosphorus control and the use of steel mixtures. Only brief reference is given to the rotary furnace and then to but one type.

There is much in the book that has a ring of sound practical experience, and which keeps one hoping for more. To satisfy the modern demand, however, would require a much larger volume or series of volumes. F. K. N.

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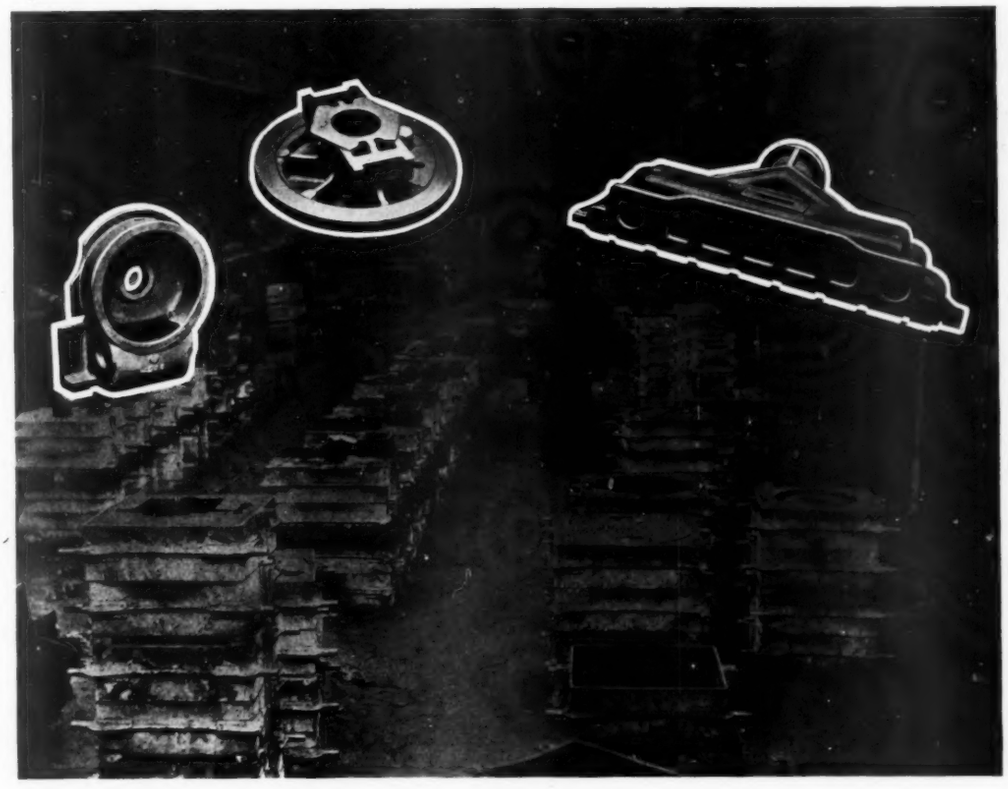

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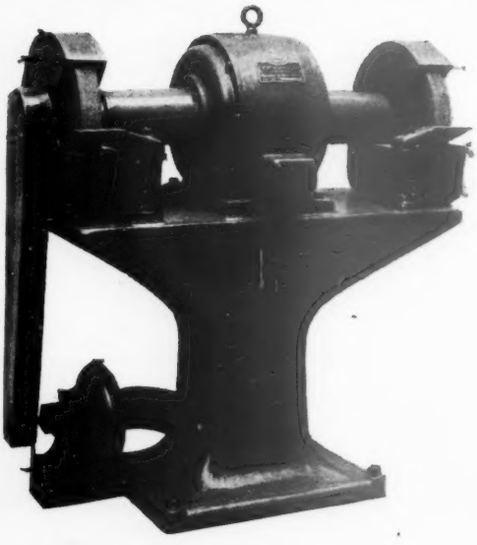

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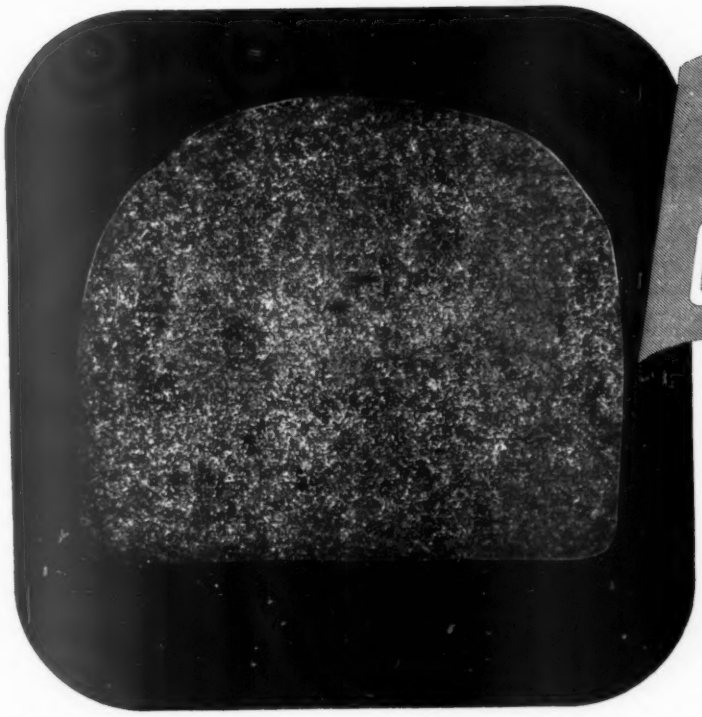

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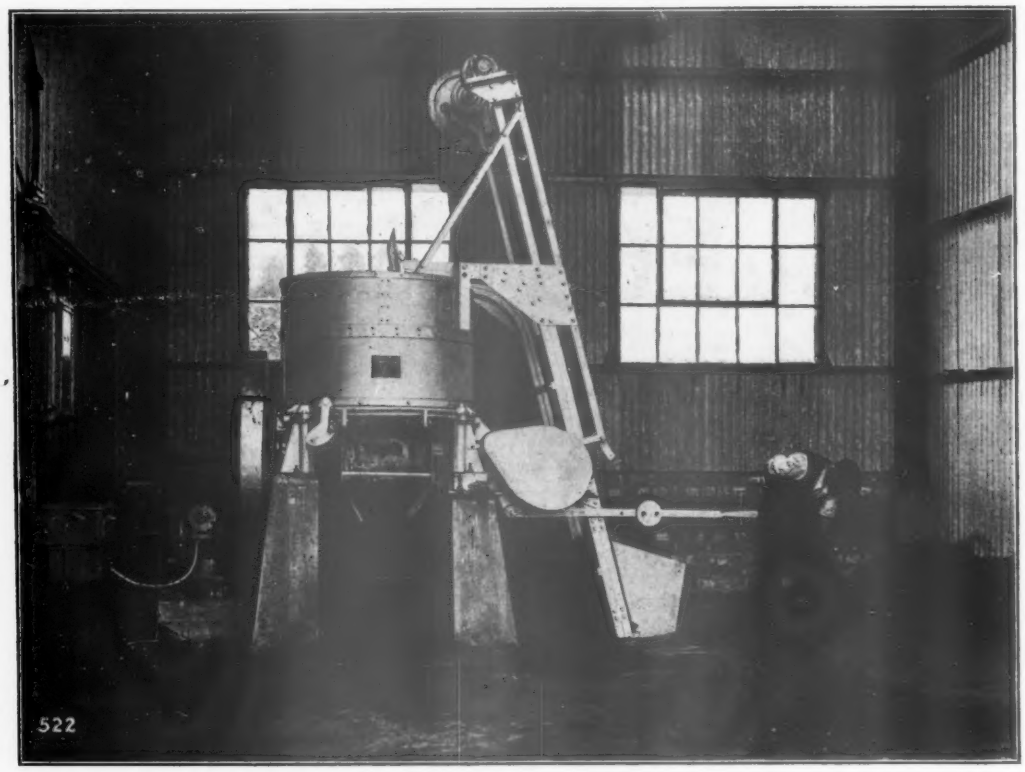

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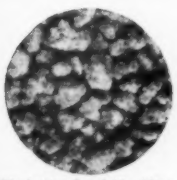
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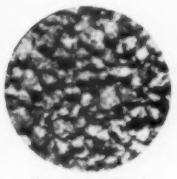
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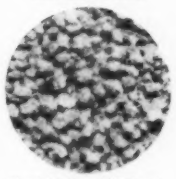
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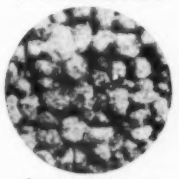
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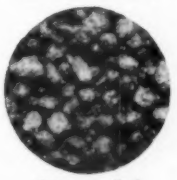
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Max. 1% car.	36 5 0		
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Metallic chromium—			
96/98%	2/5 lb.		
Ferro-manganese (net)—			
76/80% loose	£10 15 0 to 11 5 0		
76/80% packed	£11 15 0 to 12 5 0		
76/80% export	(nom.) £9 15 0		
Metallic manganese—			
94/96% carbon-free	1/3 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net. d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over .. .. 4d. lb.
Rounds and squares, under ½ in. to ¼ in. .. .. 3d. lb.
Do., under ¼ in. to 1/16 in. .. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. .. .. 3d. lb.
Do., under ⅛ in. × ¼ in. .. 1/- lb.
Bevels of approved sizes and sections .. .. 6d. lb.
Bars cut to length, 10% extra.

SCRAP

South Wales—	£	s.	d.	£	s.	d.
Heavy steel	3	2	6 to	3	5	0
Mixed iron and steel	2	17	6 to	3	0	0
Heavy cast iron	2	14	0 to	2	15	0
Good machinery	2	17	6 to	3	0	0

Cleveland—						
Heavy steel				2	15	0
Steel turnings				1	17	6
Cast-iron borings				1	7	6
Heavy cast iron				2	17	6
Heavy machinery				3	0	0

Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				3	2	6
Steel turnings				1	17	6

Scotland—						
Heavy steel	2	10	0 to	2	12	6
Ordinary cast iron	2	16	6 to	2	17	6
Engineers' turnings				2	0	0
Cast-iron borings	1	17	6 to	2	0	0
Wrot-iron piling				3	5	0
Heavy machinery	3	2	6 to	3	3	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	29	0	0
Brass	19	0	0
Lead (less usual draft)	15	10	0
Tea lead	12	0	0
Zinc	9	0	0
New aluminium cuttings	72	0	0
Braziery copper	26	0	0
Gunmetal	27	0	0
Hollow pewter	150	0	0
Shaped black pewter	115	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—

Foundry No. 1	72/6
Foundry No. 3	70/-
,, at Falkirk	70/-
,, at Glasgow	73/-
Foundry No. 4	69/-
Forge No. 4	69/-
Hematite No. 1	71/-
Hematite M/Nos.	70/6

N.W. Coast—

Hem. M/Nos. d/d Glas.	74/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-

Midlands (d/d Birmingham dist.)—

Staffs No. 4 forge	71/-
,, No. 3 fdry.	75/-
Northants forge	68/6
,, fdry. No. 3	72/6
,, fdry. No. 1	75/6
Derbyshire forge	71/-
,, fdry. No. 3	75/-
,, fdry. No. 1	78/-

Scotland—

Foundry No. 1, f.o.t.	76/6
,, No. 3, f.o.t.	74/-
Hem. M/Nos. d/d	73/6

Sheffield (d/d district)—

Derby forge	68/6
,, fdry. No. 3	72/6
Lincs forge	68/6
,, fdry. No. 3	72/6
W.C. hematite	86/-

Lancashire (d/d eq. Man.)—

Derby fdry. No. 3	78/-
Staffs fdry. No. 3	78/-
Northants fdry. No. 3	76/6
Cleveland fdry. No. 3	78/-
Dalzell. No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/-
Clyde, No. 3	83/-
Monkland, No. 3	83/-
Summerlee, No. 3	83/-
Eglinton, No. 3	83/-
Gartsherrie, No. 3	83/-
Shotts, No. 3	83/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	17	6 to	8	7	6
Hoops	10	10	0 and up.			
Marked bars (Staffs) f.o.t.			12	0	0	
Gas strip	10	10	0 and up.			
Bolts and nuts, ¾ in. × 4 in.	15	5	0 and up.			

Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	9	5	0 to	9	7	6
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅝ in. (Untested)				8	12	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	5	0 to	12	10	0
Hoops (Staffs)				9	7	0
Black sheets, 24g. (4-t. lots)				11	10	0
Galv. cor. shts. (,,)				13	10	0
Galv. flat shts. (,,)				14	0	0
Galv. fencing wire, 8g. plain				14	10	0
Billets, soft	5	10	0 and up.			
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	10	0 to	5	15	0
Tin bars	5	10	0 to	5	15	0

PHOSPHOR BRONZE

Per lb. basis.

Strip	10½d
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	11½d.
Tubes	14d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

Per lb.

Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	21.31
No. 2 foundry, Valley	19.50
No. 2 foundry, Birm.	15.50
Basic, Valley	19.00
Malleable, Valley	19.50
Grey forge, Valley	19.00
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	40.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.80
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.40
Plain wire	2.30
Barbed wire, galv.	2.80
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 20/-
Durham foundry	22/6
,, furnace	18/6 to 19/9
Scotland, foundry	28/-
,, furnace	25/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14	per box	18/9
,,	28×20	,,	37/6
,,	20×10	,,	27/-
,,	18¾×14	,,	19/6
C.W.	20×14	,,	15/6 to 16/-
,,	28×20	,,	33/6 to 34/6
,,	20×10	,,	22/9 to 23/-
,,	18¾×14	,,	15/9 to 16/-

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.		£	s.	d.
Pig-iron	6	0	0	to	7	0	0
Bars-hammered, basis	16	0	0	to	16	10	0
Bars and nail-rods, rolled, basis	15	15	0	to	16	0	0
Blooms	10	0	0	to	12	0	0
Keg steel	30	0	0	to	31	0	0
Faggot steel	18	0	0	to	23	0	0
Bars and rods dead soft, st'l	10	0	0	to	12	0	0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£ s. d.	
Dec. 18 ..	34 13 9 inc.	6/3
,, 19 ..	34 6 3 dec.	7/6
,, 20 ..	34 11 3 inc.	5/-
,, 23 ..	34 16 3 ,,	5/-
,, 24 ..	35 1 3 ,,	5/-

Electrolytic Copper

	£ s. d.	
Dec. 18 ..	39 0 0 inc.	10/-
,, 19 ..	38 10 0 dec.	10/-
,, 20 ..	39 0 0 inc.	10/-
,, 23 ..	39 0 0 No change	
,, 24 ..	39 5 0 inc.	5/-

Standard Tin (cash)

	£ s. d.	
Dec. 18 ..	220 15 0 dec.	5/-
,, 19 ..	219 15 0 ,,	20/-
,, 20 ..	218 10 0 ,,	25/-
,, 23 ..	216 15 0 ,,	15/-
,, 24 ..	216 5 0 ,,	10/-

Tin (English ingots)

	£ s. d.	
Dec. 18 ..	220 15 0 dec.	10/-
,, 19 ..	220 0 0 ,,	15/-
,, 20 ..	218 10 0 ,,	30/-
,, 23 ..	217 0 0 ,,	30/-
,, 24 ..	216 10 0 ,,	10/-

Spelter (ordinary)

	£ s. d.	
Dec 18 ..	14 18 9 inc.	1/3
,, 19 ..	14 15 0 dec.	3/9
,, 20 ..	14 17 6 inc.	2/6
,, 23 ..	14 13 9 dec.	3/9
,, 24 ..	14 15 0 inc.	1/3

Spelter (Electro, 99.9 per cent.)

	£ s. d.	
Dec. 18 ..	17 0 0 No change	
,, 19 ..	16 16 3 dec.	3/9
,, 20 ..	16 18 9 inc.	2/6
,, 23 ..	16 15 0 dec.	3/9
,, 24 ..	16 16 3 inc.	1/3

Zinc Sheets (English)

	£ s. d.	
Dec. 18 ..	23 5 0 inc.	2/6
,, 19 ..	23 0 0 dec.	5/-
,, 20 ..	23 2 6 inc.	2/6
,, 23 ..	23 0 0 dec.	2/6
,, 24 ..	23 0 0 No change	

Lead (English)

	£ s. d.	
Dec. 18 ..	18 15 0 No change	
,, 19 ..	18 10 0 dec.	5/-
,, 20 ..	18 10 0 No change	
,, 23 ..	18 5 0 dec.	5/-
,, 24 ..	18 5 0 No change	

Imports and Exports of Pig-Iron, Iron and Steel Castings, etc., in November and the eleven months, 1935, compared with a year ago.

	November.		Eleven months.		November.		Eleven months.	
	1934.	1935.	1934.	1935.	1934.	1935.	1934.	1935.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron—from British India	11,199	2,696	99,610	60,541	32,026	8,121	280,340	180,858
,, Foreign Countries	1,752	1,763	13,911	14,804	9,685	10,067	79,848	86,413
Total	12,951	4,459	113,521	75,345	41,711	18,188	360,188	267,271
Castings and forgings	314	373	3,556	2,986	8,706	10,091	89,592	81,584
Cast pipes and fittings	66	101	973	1,546	2,130	3,194	49,757	40,094
Stoves, grates, etc.	119	46	1,095	1,040	7,033	4,379	86,858	86,067
Baths	557	464	7,212	6,260	14,818	12,723	180,377	166,438
Hollow-ware, all kinds	196	235	2,115	2,390	12,281	16,361	123,138	158,369
Exports.								
Pig-iron, forge	192	135	1,224	1,740	743	625	5,074	7,435
,, foundry	8,922	9,925	67,990	86,910	31,272	33,022	233,451	299,048
,, acid	4,260	3,061	43,352	45,508	13,411	10,175	136,850	147,430
,, basic	10	—	842	829	71	—	2,796	2,650
Total	13,384	13,121	113,408	134,987	45,497	43,822	378,171	456,563
Castings and forgings	571	330	5,105	3,931	21,164	11,211	197,691	150,130
Cast pipes and fittings, up to 6 in. diameter	5,842	5,617	56,793	54,627	64,020	59,027	630,877	604,650
,, ,, ,, ,, over 6 in.	2,824	3,446	34,233	31,537	22,995	29,762	257,015	257,751
Stoves, grates, etc.	863	994	8,105	8,309	46,394	52,393	396,015	423,440
Sanitary cisterns	237	313	2,776	2,877	7,054	9,191	80,573	84,654
Bedsteads, inc. tubes therefor	413	473	4,440	4,204	14,751	18,100	151,112	154,510
Cast hollow-ware	393	443	3,458	3,965	15,072	14,275	132,304	145,764

TN ORANGE

WINCHESTER HOUSE, OLD BROAD STREET, LONDON, E.C.2.
Telegrams:- "ALKALIZE, STOCK, LONDON" Phones:- LONDON WALL 7955 (5 LINES)

AC GARNET

FINE ORANGE

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WILLIAM JACKS & Co

Partners J Gray Buchanan Stewart Barry R Russell Walker

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WHITE

RUBBER QUICKSILVER MICA

PALE LEMON

THE METAL EXCHANGE
Telegrams: "JACKS, METMA, LONDON" LONDON, E.C.3. Phone: LONDON WALL 7955

FINE WHITE

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Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FOUNDRY FOREMAN, at present engaged in general engineering castings, desires change. Practical and technical education. Age 35.—Box 508, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

CHARGE-HAND required with full knowledge of phosphor-Copper production. Write stating experience and salary required.—Box 518, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

VITREOUS ENAMELLING.—Experienced man wanted capable of making leadless fritts for sheet and cast iron for sale to the trade. All applications treated in confidence.—Box 514, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

METALLURGIST wanted with thorough knowledge of modern foundry practices and experienced in research and routine sand control. Capable of controlling mixtures and dealing with about 45 tons of grey iron daily in three grades. Apply stating experience, age and salary required, to Box 516, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MOULDER for Johannesburg. Experienced in brass and aluminium castings, and who has worked on moulding machines. Capable of acting as foreman. Wages to commence £30 per month, plus bonus on profit. Only men of first-class ability and character need apply.—KEEP BROTHERS, LTD., Great Charles Street, Birmingham.

RELIABLE man wanted to take charge of plant during night shift in North-East Coast foundry. Must be first-class maintenance engineer, and able to control men. Age and experience to be stated, with references.—Box 520, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

IRONFOUNDRY Foreman working in Lancashire town seeks position with progressive firm; 36 years' experience in modern foundry practice; Midlands preferred. (270)

MACHINERY

THOS. W. WARD LTD.

4″ Motor-driven BLOWER (Keith Blackman); 600 cub. ft. capacity p.m.; 8″ water gauge; 440 volts; 3.666 r.p.m.

Jar-ram Turnover MOULDING MACHINES (Ajax) for 19″ x 15″ boxes.

Three LANCS. BOILERS; 30′ x 8′; 140 lbs. w.p.

Two Steel DISH-ENDED RECEIVERS; 13′ 8″ long x 5′ dia.; 475 lbs. w.p.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued*

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

Tilghman Sandblast Barrel Plants; barrel sizes—60 in. x 40 in.; 36 in. x 20 in.; 20 in. x 30 in.

Tilghman Sandblast Cabinet Plants; 4 ft. 6 in. and 3 ft. 6 in. square (one for high pressure 70 lbs. per sq. in.); also small Cabinet 30 in. dia.

All complete with Air Compressors, etc.

Pneulec Royer Sand Thrower, size No. 1.

Six Osborne Pneumatic Jolt Press Moulding Machines, size 75J.

Three Mumford Yoke Headpress Pneumatic Moulding Machines.

Two Herbert Whizzer Sand Disintegrators.

Two Brealey Type ditto.

Heavy Double-ended Grinding Machines by Rowlands, Luke & Spencer, etc.

Hand Moulding Machines by Adaptable Darling & Sellars, Pridmore, Samuelson, etc.

500 Electric Motors, Dynamos, Rotary Converters, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.

'Phone: Broadwell 1359.

'Phone: 287 SLOUGH

SAND PLANT

Herbert Whizzer, large size. **£48.**
Brealey Disintegrator, NEW. **£26.**
Pneumatic Riddles, Jackman type. **£9 each.**

SANDBLAST PLANT

BARREL PLANT by Tilghman, *as new*, 60″ × 40″. Price **£240.**

NEW 8′ × 8′ ROOM PLANT, complete. Price **£230.**

CAST IRON ROOM PLANT, 12′ × 9′, complete with 400 cu. ft. motor-driven compressor for A.C. current, in new condition. Cheap.

Several small complete barrel plants in stock.

Genuine Evans 10-ton Crane Ladle. Price **£35.**

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

IDAHO PINE
YELLOW PINE

PRIME & PATTERN GRADES
½″ to 3″ thick
Width up to 24″ wide
All free of centre heart and shake

CHETHAM TIMBER Co., Ltd.,
70, FINSBURY PAVEMENT, LONDON, E.C.2
Metropolitan 7418

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LARGEST
STOCK OF HIGH-CLASS SECONDHAND
MOULDING MACHINES IN THE WORLD
Practical Advice Free

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Purchase your supplies from actual Producers with over 50 years' reputation

Scientifically treated, specially ground Ganister for Cupolas, Iron & Steel Works, &c.

SPECIAL LADLE GANISTER
TRIAL BAGS FREE
Quotations on application

The ASTBURY SILICA CO.
CONGLETON, Cheshire
Est. 50 Years

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SANDBLAST
THINK OF
RICHARDSON'S
Established 1887.

We Supply Re-Conditioned & New
SAND BLAST PLANTS
AND
AIR COMPRESSORS.

Tilghman's, Room, Barrel, Chamber, Rotary Table, Dust Arrester, and Continuous Feed Barrel Plants.

Phone: MIDLAND 2281.
Grams: "SANDBLAST, B'HAM."
R. J. RICHARDSON & SONS, Ltd.,
Commercial Street, Birmingham.

53, Victoria Street,
Westminster,
London, S.W.1.

J. N. CLIFTON
FERRO ALLOYS
Silico Manganese, etc.
Ferro Silicon.

Telegrams: Newclift, Sowest, London.
Telephone: Victoria 1852.

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DIAMITE WHEEL DRESSING TOOL
(Agent for London and District).

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The standard work of reference covering the Coal, Iron, Steel, Tinplate, Metal, Foundry, Engineering, Hardware and Allied Trades.
A new edition is now in the press. *Write us now* for full particulars and advertisement rates.
INDUSTRIAL NEWSPAPERS Ltd., 49, Wellington Street, Strand, London, W.C.2.
Telephone: Temple Bar 3951 (5 lines).

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A High Speed
Pneumatic Chipping Hammer
BRITISH MADE

'CLECO' Grinders and Sand Rammers.
John Macdonald & Co. (Pneumatic Tools) Ltd.,
POLLOKSHAWS, GLASGOW.

3
COVER
Brass and other
Copper & Nickel Alloys
WITH
CUPRIT
CLEANS THE METAL
PREVENTS: Oxidation
Evaporation of Zinc
Gives slag free from metal.
Does not attack the pots.
Cost ½d. per 100 lbs. of Metal.
Foundry Services Ltd.
Long Acre,
Nechells,
Birmingham, 7

BALDWINS LTD.
G.P.O. Box No. 286 Shell-Mex House, Strand, London, W.C.2.
Galvanized and Self-Colour Rivetted and Welded
TANKS & CISTERNS
FOR OIL AND WATER STORAGE.
CORRUGATED & PLAIN SHEETS
KEGS, DRUMS & CANS
GALVANIZED PETROL STORAGE SAFES

DURRANS
for 70 years have supplied the finest
BLACKING
NO FINER BLACKING IS USED IN ANY FOUNDRY
PLUMBAGO AND ALL FACINGS.
JAS. DURRANS AND SONS LTD.
PHŒNIX WORKS · PENISTONE · NR. SHEFFIELD.
TELEPHONE:-21 PENISTONE TELEGRAMS:-BLACKING PENISTONE.
We give Free Sample and Demonstrations by Practical Foundrymen on receipt of your enquiry.

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Composite pages generally relate to new public works and undertakings, and no objection can be taken to them when carried out on the proper lines. Any proposal, however, to participate in a composite page should be fully investigated, since it can be used as an indirect means of inducing contractors or sub-contractors to spend money on unprofitable advertisement: for example, the names of the principal undertaking or of directors or officials responsible for the placing of contracts or orders may be put forward as sponsors for the scheme, with the result that, rather than risk offence, the contractor or sub-contractor may agree to participate by giving an advertisement ; and the advertisement may be quite unprofitable to him, since the page may consist of a small amount of editorial and a large number of advertisements, and the advertisements, owing to their specialised character, may not be of interest to the bulk of the readers of the publication.

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While the proprietors of industrial establishments have every right and interest to produce books descriptive of their manufacturing facilities or welfare activities, they should examine with the utmost care any proposal whereby these books are to be produced or supplied to them free or at a reduced price ; since this project can be used as an indirect means of inducing their sub-contractors or other firms to spend money on unprofitable advertisement ; for example, the names of the proprietors of the establishment may be used to bring influence on their sub-contractors or other firms from whom they buy plant and materials, with the result that those firms may thereby be induced to take advertisement space which has no real advertising value for them.

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It cannot be too strongly emphasised that firms should examine any such proposals as are mentioned above before they agree to participate. In the case of Items 1 and 2, if they are approached for permission to allow books or special pages to be based on any undertaking in which they are interested, they should be careful to see that their name will in no way be used to bring influence to bear on sub-contractors or firms from whom they purchase.

The Council of the Trade and Technical Press,
E. O. NORTON, Secretary.

6, Bouverie Street, Fleet Street, London, E.C.4.

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FINE SILICA CEMENT.
TRADE MARK—R. DINAS.
SMARTS DINAS SILICA BRICK CO. LTD., KIDWELLY

Grain Chill and Steel ROLLS,
HEAVY CASTINGS.
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